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CONSORTIUM RESEARCH REPORT

CRAFT3D

"Enhancing traditional craft practices through 3D printing and technology innovation"

Project N. 2023-1-IT01-KA220-VET-000154806

CAMERA DI COMMERCIO DELLA BASILICATA
Luxembourg Creative Lab
INNOBRIDGE Business & Innovation Centre
NGO NEST Berlin
ambit LIVING SPACES CLUSTER
Euronet


CRAFT3D

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1. Introduction

The CRAFT3D project aims to modernize the woodworking sector by merging traditional methods with cutting-edge 3D printing technology. This collaborative effort involves various organizations, including LCL – Luxemburg, Euronet, the Italian Chamber of Commerce, BIC INNOBRIG from Bulgaria, AMBIT from Spain, and NGO Nest Berlin.

The project targets two main groups: the Main Target Group (MTG), consisting of wooden craft artisans and carpenters aged 25-45. This group requires new skills to adapt to evolving digital and labor markets, fostering innovation in wood manufacturing. The initiative prioritizes participation from disadvantaged backgrounds, including remote areas, and ensures gender balance. The Second Target Group (STG) comprises VET Providers and Educators, actively engaged in developing and testing MOOC contents and contributing to the Mentorship Programme. Recruitment for this group follows a fair and balanced process, drawing from staff members willing to acquire specific competencies and VET educators.

Work Package 2 (WP2) is dedicated to three key objectives: understanding the sector-specific innovation needs within the wood craft sector, producing and testing a tailor-made MOOC on 3D printing for this sector, and developing an assessment tool specifically for VET providers to monitor learners' progress in an online learning environment.

Research within WP2 is critical for grasping the specific needs and challenges artisans face in integrating technological advancements into their practices. These insights inform the development of a practical and engaging MOOC, ensuring its relevance and appeal to students.

Consortium Research Report provides an in-depth examination of CRAFT3D's MOOC and Assessment Tool, elucidating their pivotal roles in empowering artisans, driving innovation, and shaping the future of the woodworking sector.

2. LCL - Luxembourg

Introduction

Welcome to our focus-group interview, a dynamic forum where diverse perspectives converge to explore and discuss crucial aspects of our project initiatives. We are delighted to have a diverse group of participants, including craftsmen, VET providers, and other stakeholders, gathered to share insights and collectively contribute to the success of our endeavors. This collaborative session aims to delve into key themes, exchange experiences, and identify strategies that will shape the future trajectory of our project. Your active participation is not only valued but essential as we work towards fostering innovation and enhancing skills in the wood crafting sector. Let's embark on this insightful journey together, leveraging our collective expertise to make a lasting impact on our shared objectives.

Best Practice

Best Practice title: BTS Wood Technology

Project partner: Luxembourg Creative Lab a.s.b.l.

Topic	**VET-Craftsmen Synergy: Elevating Skills Through Collaborative Learning**
Best practice Title	**BTS Wood Technology (BTS « Technologie Bois »)**
Keywords	**Vocational Education and Training (VET), Craftsmen, Carpentry, Skill Enhancement, Collaborative Learning, Tailored Programs, Industry-Integrated Curriculum, Apprenticeships, Lifelong Learning, Innovation, Luxembourg.**

Best practice
In Luxembourg, the innovative best practice known as BTS Wood Technology (BTS « Technologie Bois ») exemplifies the effective collaboration between Vocational Education and Training (VET) and craftsmen, with a specific focus on joinery, wood carpentry, wood construction, interior design and the wood industry.

This initiative is designed to empower craftsmen and carpenters by providing tailored educational

support that enhances their skills and fosters continuous professional development.

Key Features:

1. **Tailored Educational Programs:**
    - The "Wood Technology" BTS offers attractive opportunities in a variety of fields, including joinery, wood carpentry, wood construction, interior design and the wood industry of the craft sector.
2. **Industry-Integrated Curriculum:**
    - The best practice integrates industry-relevant content into the curriculum, creating a seamless transition from classroom learning to practical application. Craftsmen benefit from a curriculum that mirrors real-world scenarios, enhancing their ability to apply theoretical knowledge in their daily craft activities.
3. **Apprenticeship Opportunities:**
    - BTS « Technologie Bois » encourages apprenticeship opportunities for craftsmen, providing them with hands-on experience in a real-world working environment. This apprenticeship model fosters a mentor-mentee relationship, enabling craftsmen to learn from seasoned professionals while contributing to ongoing projects.
4. **Lifelong Learning Initiatives:**
    - Recognizing the dynamic nature of the craft industry, the best practice promotes lifelong learning initiatives. Craftsmen are encouraged to engage in continuous professional development, accessing workshops, seminars, and online courses that keep them abreast of the latest trends, technologies, and best practices.
5. **Innovation Hubs and Workshops:**
    - BTS « Technologie Bois » establishes innovation hubs and workshops where craftsmen can explore and experiment with new technologies, tools, and materials. These hubs serve as collaborative spaces for knowledge exchange, sparking innovation within the craft community.
6. **Mentorship Programs:**
    - The initiative incorporates mentorship programs, connecting experienced craftsmen with those newer to the field. This mentorship not only facilitates skills transfer but also provides valuable insights into the nuances of running a successful craft business.
7. **Flexible Learning Paths:**
    - Recognizing that craftsmen may have varied schedules and commitments, BTS « Technologie Bois » offers flexible learning paths. Whether through evening classes, weekend workshops, or online modules, the initiative ensures accessibility for

craftsmen at different stages of their careers.

8. **Digital Literacy Integration:**

    - To keep pace with technological advancements, the best practice integrates digital literacy components into the curriculum. Craftsmen are equipped with the skills to leverage digital tools for design, marketing, and project management, enhancing their overall competitiveness.

Success Factors:

- The success of BTS « Technologie Bois » lies in its commitment to tailor-made education, industry integration, apprenticeship opportunities, lifelong learning, innovation hubs, mentorship, flexible learning paths, and digital literacy. By embracing these features, the best practice exemplifies a dynamic and collaborative approach to supporting craftsmen and carpenters in Luxembourg, ultimately elevating the skills and resilience of the craft community.

(Please keep this description to a limit. The case study must be at least 1 page)

Reference Link (if any)	https://ln.lu/informations/bts-bois/
Provided By	- *https://ln.lu/informations/bts-bois/* BTS « Technologie Bois » Mail: secretariat-direction@lnw.lu Adresse: Lycée du Nord 19, rue Général Patton L-9551 WILTZ
Language	ENGLISH/FRENCH

Survey and Focus Group

The focus-group interview conducted by the Luxembourg Creative Lab involved a diverse group of 18 participants, showcasing a well-balanced representation from both Vocational Education and Training (VET) providers and professionals from the crafting sector. All participants were aged 18 and above, ensuring a mature and experienced perspective in the discussions. Notably, the composition of the participants included individuals actively engaged in the Luxembourg labor market, contributing their expertise and insights to the dialogue. Within the crafting sector, a significant 75% of the craftsmen not only operate within Luxembourg but also extend their business reach across neighboring countries. This international dimension brings valuable perspectives on cross-border challenges and opportunities in the wood crafting industry. The inclusion of VET providers ensures a comprehensive understanding of educational dynamics and potential areas of collaboration between education and industry. This diverse profile of participants fosters a rich and well-rounded discussion, encompassing the varied experiences and expertise within the wood craft sector in Luxembourg and beyond.

The current state of the wood crafting sector in Luxembourg and partner countries appears to be dynamic yet holds certain challenges. In Luxembourg, for instance, there is a robust tradition of woodworking craftsmanship, but there is a need for modernization and the infusion of digital technologies like 3D printing. In partner countries, the situation may vary, and understanding these nuances is crucial. Challenges may include the integration of traditional craftsmanship with emerging technologies, ensuring sustainability practices, and addressing skills gaps in the workforce. The focus group aims to explore these aspects in detail to better inform the project's objectives and strategies. During the focus-group interview a significant concern among respondents in Luxembourg, with a substantial 71% indicated a lack of skills in 3D printing. This insight underscores a critical need for targeted initiatives and educational programs aimed at addressing the skills gap in this innovative technology. The Luxembourg Creative Lab and its collaborative efforts with VET providers appear timely and essential to bridge this gap, empowering artisans and carpenters with the necessary knowledge and expertise in 3D printing. Understanding and addressing this identified challenge will be instrumental in fostering a more digitally adept workforce in the wood crafting sector.

1. **What is the VET current situation on the labour market and what are the existing education opportunities across Luxembourg?**

Luxembourg's vocational education and training (VET) system is centrally administered by the Ministry of National Education, Children and Youth, with higher VET falling under the Ministry of Higher Education and Research. The dual system is a key component of secondary-level VET, fostering strong connections between school- and work-based learning. The 2008 VET reform introduced a competence-based, modular approach and reinforced links to the labor market. Secondary VET prepares learners for professional life and higher education, offering vocational three-year programs with apprenticeships, technician programs, and technical programs in various fields. Learners can progress from VET to general secondary education and vice versa. At the tertiary level, VET provides short-cycle studies leading to a higher technician certificate (BTS), with opportunities to continue into bachelor studies or enter the labor market. Adult learners, regardless of age or employment status, have access to formal and non-formal learning, supported by guidance and incentives for continuous vocational education and training (CVET). Training is facilitated by various entities, including the State, professional chambers, sectoral organizations, private training centers, and the public employment service, with an emphasis on sectoral qualifications for non-regulated CVET.

2. Explain any educational gaps in the wood craft sector in Luxembourg?

However, the following gaps were identified as being potential areas for consideration or exploration based on the VET representatives' responses:

1. Alignment with Industry Trends:
    - Educational programs may need continuous adaptation to align with evolving trends and technologies in the wood craft sector. Ensuring that the curriculum reflects the latest advancements can help bridge potential gaps.
2. Incorporation of Emerging Technologies:
    - Given the transformative nature of technology, there could be a need to assess whether educational programs sufficiently integrate emerging technologies relevant to wood crafting, such as digital design tools or advanced machinery.
3. Accessibility and Inclusivity:
    - Ensuring equal access to educational opportunities for individuals from diverse backgrounds and demographics is essential. Identifying and addressing any disparities in access can contribute to a more inclusive educational environment.
4. Industry-Ready Skills:
    - Evaluating whether the educational programs adequately equip learners with practical, industry-relevant skills and experiences can help bridge potential gaps between academic knowledge and workplace demands.
5. Feedback Mechanisms:
    - Establishing effective feedback mechanisms between educational institutions and the wood craft industry can provide insights into the industry's evolving needs. Regular communication channels can help identify and address any gaps in preparing students for the workforce.

3. As an artisan or carpenter, what specific needs and gaps do you identify in the wood crafting sector, especially concerning the integration of digital technologies like 3D printing?

As artisans and carpenters in Luxembourg, the survey responses underscore a specific need for enhanced training and skill development, particularly in the integration of digital technologies like 3D printing within the wood crafting sector. The identified gap centers around a desire for more comprehensive training programs that specifically address the intricacies of incorporating 3D printing into traditional woodworking practices. Respondents expressed a keen interest in acquiring practical knowledge and hands-on experience, emphasizing the importance of tailored educational initiatives to bridge this gap effectively. The Luxembourg Creative Lab's initiative to

empower artisans and carpenters through specialized 3D printing training aligns well with the expressed needs of the surveyed professionals.

4. **In your experience, what professional skills do you believe are crucial for VET providers to address in order to meet the demands of the evolving labor market in the wood crafting industry?**

In light of the facilitated session, where over 80% of respondents expressed a pressing need for enhanced digital skills, VET providers must prioritize certain key competencies to meet the evolving demands of the labor market in the wood crafting industry. The identified professional skills include:

- Digital Design Process Facilitation: VET providers should focus on equipping artisans with the skills to navigate and streamline the digital design process for crafting. This involves proficiency in digital design tools and software tailored to the woodworking context.
- 3D Printing Skills: Considering the explicit demand for 3D printing skills, VET programs should incorporate comprehensive training on 3D printing technologies, covering both theoretical understanding and practical application within the wood crafting domain.
- Digital Research Skills: Artisans expressed a need for improved digital research skills. VET providers should emphasize training in effective digital research methodologies, enabling craftsmen to stay updated on industry trends, materials, and techniques.
- Visualization Skills: Enhancing artisans' ability to visualize and conceptualize their craft digitally is crucial. VET programs should include modules on visualization techniques, enabling craftsmen to effectively translate their ideas into digital formats.
- Digital Marketing Skills: To promote craft productions and ensure profitability, VET providers should integrate training in digital marketing strategies. This includes understanding online platforms, e-commerce, and social media to effectively showcase and market crafted products.

By addressing these specific skills, VET providers can play a pivotal role in empowering artisans within the wood crafting industry to thrive in the evolving digital landscape, ensuring they are well-equipped to meet market demands and achieve sustainable success.

5. **How do you envision the integration of 3D printing as a catalyst for innovation in the craft sector, and what potential benefits or challenges do you foresee?**

The integration of 3D printing in the craft sector in Luxembourg will hold immense potential as a catalyst for innovation. Envisioning this integration positively, we anticipate several benefits for artisans and the industry as a whole. Firstly, 3D printing will allow for unprecedented levels of creativity and customization, enabling artisans to bring intricate and unique designs to life with greater ease. This technology will facilitate rapid prototyping, accelerating the product development cycle and fostering a culture of experimentation. Moreover, the incorporation of 3D printing could lead to increased efficiency in production processes, reducing waste and optimizing resource utilization. This not only aligns with sustainable practices but also contributes to cost-effectiveness and improved competitiveness within the market. While the potential benefits are promising, challenges may include the initial investment in technology and training. However, with the right support and training programs provided by VET trainers across Luxembourg, these challenges can be overcome, paving the way for a more digitally empowered and innovative craft sector. Overall, the integration of 3D printing is poised to

revolutionize craftsmanship, offering new avenues for creativity, sustainability, and economic growth.

6. **For artisans and carpenters aged 25-45, what knowledge and skills do you believe are essential for navigating the new digital landscape, particularly in the context of 3D printing?**

For artisans and carpenters aged 25-45 who are active in Luxembourg, navigating the new digital landscape, especially in the context of 3D printing, requires a blend of foundational knowledge and specific skills.

- Digital Literacy: A fundamental understanding of digital technologies, including basic computer skills, file management, and familiarity with digital interfaces, is essential.
- 3D Printing Fundamentals: Comprehensive knowledge about the principles and functionalities of 3D printing, covering aspects like different printing techniques, materials, and the operation of 3D printers.
- Digital Design Skills: Proficiency in digital design tools and software is crucial. Artisans should be adept at creating and manipulating 3D models using design software tailored to the wood crafting and 3D printing context.
- Material Understanding: Knowledge about materials compatible with 3D printing in woodworking, including their properties, strengths, and limitations. This ensures informed decision-making in material selection for printing.
- Workflow Integration: The ability to integrate 3D printing seamlessly into existing workflows, from conceptualization to final production. This includes understanding how 3D printing fits into the larger crafting process.
- Collaboration and Networking: Emphasis on collaborative skills to engage with digital communities, share knowledge, and stay updated on industry trends. Networking can open avenues for shared learning and potential collaborations.
- Digital Marketing Awareness: Understanding the basics of digital marketing, particularly in showcasing 3D-printed craft products online. This involves utilizing social media platforms, e-commerce, and other online channels to promote and sell creations.

By acquiring these knowledge and skills, artisans and carpenters across Luxembourg in the specified age range can effectively navigate the digital landscape, leveraging the potential of 3D printing to enhance their craft, drive innovation, and remain competitive in the evolving market.

7. **Can you share any experiences or examples of how 3D printing has been utilized in the wood crafting industry, either by you or others in your field?**

The respondents shared that in Luxembourg, artisans and carpenters have embraced the integration of 3D printing in the wood crafting industry, showcasing its versatility and transformative impact. Craftsmen have utilized 3D printing to create customized tools, optimizing traditional woodworking processes with ergonomic handles and specialized jigs. The technology has been instrumental in producing ornate wood carvings, allowing for intricate designs and patterns by using 3D-printed templates as guides. Furthermore, artisans leverage 3D printing for prototyping and design testing, facilitating a cost-effective and efficient way to assess the feasibility and aesthetics of projects before full-scale production. Complex joinery and precision-designed connectors are crafted through 3D printing, pushing the boundaries of innovation in wood assemblies. Custom furniture components, such as uniquely shaped knobs and handles, add a personalized touch to pieces. Additionally, educational initiatives in

Luxembourg integrate 3D printing into woodworking education, allowing students to explore the fusion of traditional craftsmanship and modern technology. These examples collectively highlight how 3D printing has become an invaluable tool, enhancing creativity, customization, and efficiency within the wood crafting landscape.

8. **What kind of training or educational support would you find most effective in empowering artisans and carpenters to embrace 3D printing technology and its practical applications?**

Respondents expressing a need to understand the basics and fundamentals of 3D printing for its application in various aspects of their work highlight a crucial demand for targeted training and educational support. A comprehensive training program should begin with foundational modules covering the principles of 3D printing, including its techniques, materials, and operational aspects. Practical hands-on sessions, demonstrating the integration of 3D printing into woodworking processes, would be highly effective. Workshops focused on creating 3D models specific to woodworking applications, using design software, would empower artisans with practical skills. Additionally, tailored guidance on selecting materials compatible with 3D printing in the context of woodworking projects would be essential. The training should extend to troubleshooting common issues that may arise during the 3D printing process, ensuring artisans are equipped to navigate challenges effectively. An interactive and collaborative learning environment, potentially facilitated through online platforms or community workshops, would foster shared experiences and knowledge exchange among artisans. Overall, a holistic training approach encompassing theoretical knowledge, hands-on experience, and collaborative learning would effectively empower artisans and carpenters to embrace 3D printing technology and apply it practically in their craft.

9. **What challenges does the VET sector in Luxembourg currently encounter within this field?**

However, the concerns voiced by VET representatives regarding the lack of knowledge to prioritize learning objectives in a 3D Printing for Crafts program highlight a significant challenge in the development of effective training initiatives. To address this, a collaborative effort involving industry experts, educators, and artisans is crucial to identify and prioritize key learning objectives. Establishing a clear framework that aligns with the specific needs and challenges of the Luxembourg wood crafting sector is essential. Moreover, the expressed uncertainty about the competitiveness of such training compared to neighboring countries suggests the importance of benchmarking against successful programs in France, Germany, and Belgium. Conducting a thorough analysis of the strengths and weaknesses of existing programs in these countries can provide valuable insights. This comparative approach can guide the development of a program tailored to Luxembourg's unique requirements, potentially incorporating elements that set it apart and make it more attractive to prospective learners. Furthermore, collaboration with international partners and leveraging best practices from neighboring countries could enhance the program's quality and competitiveness. Addressing these concerns requires a strategic approach, involving stakeholder engagement, industry collaboration, and a commitment to continuous improvement to ensure the 3D Printing for Crafts program meets and exceeds industry standards.

10. **How can the results produced by the Erasmus+ co-funded project 'Craft 3D' impact the VET providers across Luxembourg to bridge the gap between traditional wood crafting skills and the integration of 3D printing techniques?**

The results produced by the Erasmus+ co-funded project 'Craft 3D' have the potential to significantly impact VET providers across Luxembourg by providing a structured framework to bridge the gap between traditional wood crafting skills and the integration of 3D printing techniques. Here are several ways in which these results can have a positive impact:

- **Training Materials:** The project can contribute to the development of standardized training materials, including guides, manuals, and educational resources. These materials can serve as valuable assets for VET instructors, providing them with the necessary tools to effectively teach 3D printing techniques to artisans and carpenters.
- **Skill Assessment Standards:** The project can contribute to the establishment of standardized skill assessment standards related to 3D printing in wood crafting. This ensures that VET providers have clear benchmarks to evaluate the proficiency of learners and tailor their training accordingly.
- **Industry Collaboration:** The results can foster closer collaboration between VET providers and the wood crafting industry. By aligning training programs with the practical needs of the industry, VET providers can ensure that graduates are well-prepared to meet the demands of the evolving labor market.
- **Professional Development for Instructors:** The project outcomes can facilitate the professional development of VET instructors, providing them with insights into the latest advancements in 3D printing technology and its applications in wood crafting. Continuous training for educators ensures they remain at the forefront of industry trends.
- **Awareness and Promotion:** The results can be utilized to raise awareness about the importance of integrating 3D printing in wood crafting. VET providers can actively promote these advancements to attract potential learners and demonstrate the relevance of their programs in the contemporary digital landscape.

By leveraging the insights and outcomes of the 'Craft 3D' project, VET providers in Luxembourg can proactively address the skills gap, empower artisans with cutting-edge knowledge, and contribute to the overall advancement of the wood crafting industry.

11. **In your opinion, what role does the adoption of 3D printing play in fostering innovation within the wood crafting sector, and how can this innovation benefit artisans and carpenters?**

The adoption of 3D printing in the wood crafting sector plays a pivotal role in fostering innovation, offering transformative benefits for artisans and carpenters as well as for the whole VET sector across Luxembourg. Here's an overview:

Fostering Innovation:

- Design Flexibility: 3D printing allows for intricate and complex designs that may be challenging or impossible to achieve through traditional woodworking methods.
- Rapid Prototyping: Artisans can quickly iterate and test prototypes, enabling faster product development cycles and reducing time-to-market for new creations.

- Customization: The technology enables personalized and bespoke designs, catering to individual preferences and client requirements.
- Material Exploration: 3D printing opens up possibilities with a variety of materials, expanding the range of options for woodcrafters to experiment with innovative combinations and structures.

Benefits for Artisans and Carpenters:

- Enhanced Creativity: Artisans can unleash their creativity without the constraints of traditional manufacturing, pushing the boundaries of what is possible in woodworking.
- Efficiency and Precision: 3D printing allows for precise and consistent production, reducing material waste and enhancing overall efficiency in crafting.
- Market Competitiveness: Artisans adopting 3D printing gain a competitive edge by offering unique and innovative products that stand out in the market.
- Cost-Effective Prototyping: The ability to create prototypes economically enables artisans to test ideas without investing heavily in traditional prototyping processes.

Attractiveness of VET:

- Cutting-Edge Curriculum: VET programs can become more attractive by offering cutting-edge curricula that incorporate 3D printing into traditional woodworking courses.
- Hands-On Training: Practical, hands-on training using 3D printing technology can make VET programs more appealing, providing students with valuable skills applicable in real-world scenarios.
- Industry Collaboration: Collaborating with industry experts and integrating real-world projects into the curriculum enhances the relevance and attractiveness of VET programs.
- Internships and Apprenticeships: Offering opportunities for internships and apprenticeships with companies at the forefront of 3D printing in wood crafting provides students with real-world experience and boosts the attractiveness of VET.

In summary, the adoption of 3D printing across Luxembourg brings about innovation in design, prototyping, and material usage, benefiting artisans with enhanced creativity, efficiency, and market competitiveness. VET programs can attract students by staying ahead of industry trends, offering practical training, fostering collaboration with the industry, and providing hands-on experiences with cutting-edge technologies.

12. Do you have any further recommendations?

Craftsmen express a preference for staying connected through the informal and interactive platform of Facebook, where they can engage in discussions, share insights, and participate in a community atmosphere. On the other hand, VET providers lean towards the professional network of LinkedIn, valuing its professional tone and suitability for networking within the educational sector. Additionally, VET providers appreciate staying informed through newsletters, a formal and structured communication method that allows for comprehensive updates and announcements related to project initiatives. Balancing these preferences ensures effective and

inclusive communication across diverse stakeholders, fostering a collaborative and informed community.

Summary of the Focus-group Interview

The Luxembourg Creative Lab recently conducted a focus-group interview involving 18 participants, creating a balanced mix of Vocational Education and Training (VET) providers and skilled craftsmen, all aged 18 and above. Notably, 75% of the craftsmen participants actively sell their products not only within Luxembourg but also across neighboring countries. This international dimension adds a unique perspective to the discussions, highlighting potential cross-border challenges and opportunities within the wood crafting sector. The diverse composition of the participants, with representation from both the education and industry sectors, ensures a comprehensive dialogue, fostering insights into the intricate dynamics of vocational education, craftsmanship, and the interplay between the two in Luxembourg and its neighbouring regions.

Desk Research

The combined insights gathered from the focus group interview and the comprehensive survey conducted among Vocational Education and Training (VET) participants and wood craft artisans in Luxembourg unveil a nuanced understanding of the current landscape and future requirements for technological integration in the craft industry.

1. Current Technological Landscape
- The majority of participants, particularly those in the 26-35 age range, recognize the limited integration of technologies, such as 3D printing and Automated Woodworking Machines, in the wood craft sector. This observation is crucial, emphasizing the existing gap between traditional craftsmanship and modern technological advancements.

2. Training and Skill Development
- A significant finding is the absence of prior participation or provision of training programs focused on integrating new technologies. This underscores a critical need for targeted educational initiatives that bridge this knowledge gap. The diverse responses regarding the current use of technological innovations emphasize the varied understanding within the industry, necessitating a standardized educational approach.

3. Interest in Learning Modules
- The interest expressed in specific learning modules, such as 3D printing introduction and CAD modeling software, reflects a proactive willingness among artisans and carpenters to embrace technological advancements. Customized training courses aligned with these preferences can significantly contribute to skill enhancement.

4. Assessment of Progress and Perceived Impact
- The self-assessment approach adopted by wood craft artisans and carpenters indicates a desire for hands-on, practical learning experiences. The perceived impact of new technologies, including enhanced craftsmanship and adaptability to market demands, highlights the industry's

acknowledgment of the transformative potential of technology.

5. Identified Needs and Challenges:
- The articulated needs, including access to new projects and the ability to work on complex parts with precision, demonstrate a forward-looking perspective. However, challenges such as a limited qualified/specialized workforce, lack of access to technology, and high implementation costs signify the barriers that must be addressed to facilitate seamless integration.

Conclusion of Desk Research

The combined findings from the focus group interview and survey shed light on the intricate dynamics of Luxembourg's VET and wood craft sector, signalling both its potential for technological evolution and the challenges that must be navigated. As we conclude this comprehensive analysis, it becomes evident that the craft industry in Luxembourg stands at the cusp of a transformative journey, one that harmonizes traditional craftsmanship with the possibilities afforded by modern technology.

- Potential for Technological Evolution

Luxembourg's artisans and carpenters, particularly those within the 26-35 age range, showcase a readiness to embrace technological advancements. The expressed interest in specific learning modules, such as 3D printing introduction and CAD modeling software, unveils an industry eager to evolve its skill set. This eagerness is a promising foundation upon which tailored Vocational Education and Training (VET) programs can be built.

- Customized Education as a Catalyst

The absence of prior participation in technology-focused training programs underscores a crucial opportunity for educational interventions. Customized courses that resonate with the preferences of wood craft artisans and carpenters, as articulated through the survey and focus group, can serve as a catalyst for skill development. These initiatives should adopt a hands-on, practical approach, aligning with the self-assessment model favored by industry professionals.

- Addressing Identified Needs and Challenges

The identified needs, such as access to new projects and the ability to work on complex parts with precision, should guide the design of educational modules. Simultaneously, the acknowledged challenges – a limited qualified/specialized workforce, lack of access to technology, and high implementation costs – necessitate targeted interventions. Collaborative efforts between educational institutions, industry stakeholders, and governmental bodies are essential to overcome these barriers and create an environment conducive to technological integration.

In closing, this analysis unveils not only the current state but also the immense potential for Luxembourg's wood craft sector. By embracing the opportunities presented by technology and investing in tailored education, the industry can navigate the challenges, ensuring its resilience and relevance in the ever-evolving landscape of craftsmanship.

Photos

3. EURONET and Camera di Commercio della Basilicata - Italy

Introduction

The aim of the Italian research phase conducted by Basilicata Chamber of Commerce – Euro-Net, within the framework of WP2, is to analyze the needs of the project stakeholders involved in this project, in order to understand how to utilize these results in the activities of the next step..
The completion of the research phase under WP2 is a pivotal step in understanding and catering to the specific needs and expectations of the stakeholders involved in this project. The primary aim has been to conduct a thorough analysis of these requirements to inform the strategic direction of subsequent activities. By gaining a deep insight into the stakeholders' perspectives, the project is better positioned to deliver meaningful and impactful outcomes.
Indeed, the results of the research will be used to develop a MOOC's modules that can support wood craft artisans and carpenters to integrate innovation technology in their work.
To encapsulate and disseminate the findings from this phase effectively, a national report has been prepared. This report serves as a comprehensive repository of all the outputs generated

during the research phase. It details the methodologies employed in identifying stakeholder needs, the insights gained, and the implications for the project's future trajectory. Furthermore, the report outlines how these findings will be translated into the development of the MOOC's modules, illustrating the practical steps towards achieving the integration of innovation in woodcraft and carpentry.

Best Practice 1

Best Practice title: "ABITARE MEGLIO" "LIVE BETTER"

Topic	3D processing on wood
Best practice Title	"ABITARE MEGLIO" "LIVE BETTER"
Keywords	# woodenhouses; # livingwood # environment # sustainability

Best practice

Wood, recognized for its exceptional physical-mechanical characteristics, has emerged as the primary construction material for countries prioritizing living well-being. Acknowledged by the Construction Products Directive (89/106/EEC), Eurocodes, and Technical Standards for Constructions, wood's inherent qualities offer numerous advantages:

- Comfort and Living Well-being: Wood, wood fibers, and cork provide comfort at room temperatures, contrasting with materials like cement or stone that require higher temperatures to feel comfortable. This is crucial given the significant amount of time people spend indoors.

- Eco-compatibility: As a sustainable material, wood is unparalleled. It is renewable, recyclable, and has a low energy production footprint. It does not emit harmful substances during use and contributes to CO2 storage, aligning perfectly with eco-friendly construction principles.

- Thermal Protection and Energy Saving: Wood's low thermal conductivity and high thermal inertia contribute to significant energy savings by reducing the need for heating in winter and air conditioning in summer.

- Fire Safety: Despite being combustible, wood structures offer predictable and safe fire resistance. The formation of a protective char layer slows down combustion, providing a measure of safety without releasing toxic fumes.

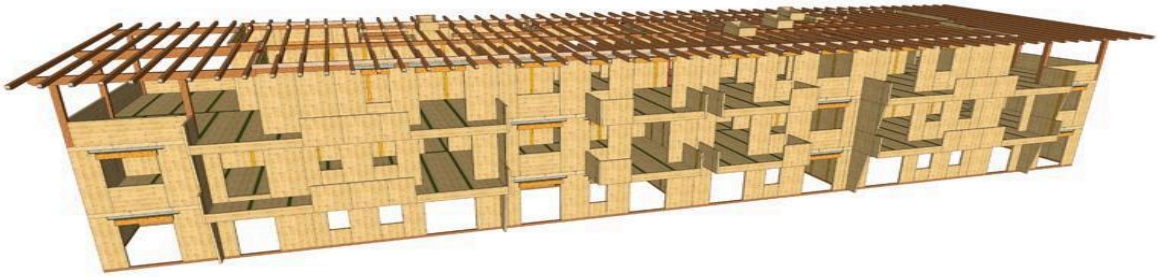
- Statics and Seismic Protection: Wood's lightness, coupled with the ductility of joints and dissipative capacity, makes it ideal for seismic protection, offering superior strength-to-weight ratios.

- Noise Protection: The fibrous nature of wood provides excellent sound absorption, making it suitable for environments requiring high acoustic standards.

- Safety, Ease of Use, and Durability: With a projected durability of 50 years, wood's ease of processing, ergonomic benefits, and design flexibility make it a preferred choice in construction.

ABILEGNO STRUCTURES specializes in laminated wood construction, blending aesthetics with functionality. Founded in 1969, the company stands on the dual pillars of customization and innovation, collaborating with research institutions to advance wood technology.

ABITARE MEGLIO represents a philosophy of constructing environments free from harmful materials, focusing on well-being, resource efficiency, and environmental preservation. Wooden houses, employing systems like Blockhaus, Timber Frame, and X-LAM, embody this philosophy, offering sustainable, energy-efficient, and aesthetically pleasing solutions. The X-LAM system, in particular, is highlighted for its blend of traditional appearance and modern benefits, making it Abilegno's recommended choice for construction projects seeking the advantages of wood without compromising on quality or safety.



Reference Link (if any)	https://abilegno.com
Provided By	*- Name of the Institution/Partner that implemented the practice:* Abilegno *- Contact of the Institution/Partner (name, email, telephone):* C.da Palombara 18 - 85034 Francavilla in Sinni (PZ)- ITALY Phone: +39 0973 - 577177 Fax: +39 0973 - 577177 Email: info@abilegno.com *- Name of the Strategy/Programme:* *- Other useful information (if any):*

Language	ENGLISH

Best Practice 2

Best Practice title: THE BREAD STAMP

Topic	3D processing on wood
Best practice Title	**THE BREAD STAMP**
Keywords	#breadstamp; #design&tradition #lucancarpenteryschool #carpenterforaday

Best Pratictice

The bread stamp, a distinctive symbol of Matera's pastoral tradition, beautifully merges design and tradition. Historically, these hand-carved wooden stamps bore the family's initials or symbols on the bottom, while the top featured decorations of architectural, religious elements, human figures, or pets, symbolizing virility and prosperity. Beyond their practical use for identifying bread in communal ovens, bread stamps held allegorical significance and were part of romantic rituals, exchanged as tokens of affection.

In contemporary times, the bread stamp has transitioned into a decorative element, enriching both modern and antique interiors, and occasionally marking quality features of products. Massimo Casiello, leveraging his background in IT, embraced his roots in Matera to innovate in the realm of artistic woodworking. Establishing the first national woodturning art studio in the Sassi districts in 2010, Casiello uniquely integrates traditional craftsmanship with modern technology, including CNC machines, laser cutters, and 3D printers.

Collaborating with designers and firms worldwide, Casiello extends his craft through educational initiatives, operating the first and only carpentry school in Lucania, situated in Sasso Caveoso. This environment fosters a blend of ancient wisdom and contemporary innovation. Among his offerings is a unique experience titled "The stamp of the bread made by you- Be a carpenter for a day," allowing participants to craft their personalized bread stamp, bridging the gap between traditional art and personal expression.

Reference Link (if any)	https://www.massimocasiello.it/
Provided By	*- Name of the Institution/Partner that implemented the practice:* Art Studio e Falegnameria Didattica *- Contact of the Institution/Partner (name, email, telephone):* Via San Francesco da Paola Vecchio, 15 75100 – Matera Telephone: +39 0835 1970309 Mobile: +39 329 3382454 Mail: info@massimocasiello.it *- Name of the Strategy/Programme:* *- Other useful information (if any):*
Language	ENGLISH

Best Practice 3

Best Practice title: TROLLEY Caciocavallo Impiccato

Topic	3D on wood
Best practice Title	**TROLLEY Caciocavallo Impiccato**
Keywords	# familybusiness #innovativeideas #traditionalfoodproducts #caciocavalloimpiccato

Best Practice

Falegnameria Salandra, a family-run Italian business established in 1973 in Acerenza (PZ), specializes in custom-made furniture, utilizing a team of qualified collaborators. The company is recognized for its robust organization, meticulous project management alongside designers, and adherence to planned procedures that guarantee cost control, quality assurance, and the realization of the desired aesthetic-functional outcomes. The process involves an initial analytical offer and sample construction, followed by an on-site survey and technical design using innovative 2D-3D Cad-Cam software to optimize the production phases including cutting, assembling, sanding, and painting.

One of their notable creations is the Caciocavalloimpiccato Trolley, a gourmet cart designed for restaurants and catering services, aimed at celebrating the traditional Italian delicacy of Caciocavallo Impiccato. This dish has roots in the ancient transhumance traditions of Basilicata, where shepherds would carry the Caciocavallo cheese on horsebacks and melt it over embers. Falegnameria Salandra's trolley incorporates a practical folding rod for melting the cheese, offering a sophisticated and interactive dining experience. The design embodies elegance and class, intended to surprise and engage customers while paying homage to a beloved regional tradition.

Reference Link (if any)	http://www.salandra.eu/it www.caciocavalloimpiccato.net https://www.lagazzettadelmezzogiorno.it/news/curiosita/1365236/il-caciocavallo-impiccato-diventa-un-marchio-brevettato.html
Provided By	*- Name of the Institution/Partner that implemented the practice:* Falegnameria Salandra *- Contact of the Institution/Partner (name, email, telephone):* C.da Alvanello, snc -diga di Acerenza – Potenza- ITALY Telephone: +390971.944221 Mobile: +39349.6676792 Email: salandra@pec.it info@salandra.eu *- Name of the Strategy/Programme:* *- Other useful information (if any):*

Language	ENGLISH

Survey and Focus Group

Participant Demographics

- the majority of participants (55%) is aged more than 46 year;
- the most part of participants (85%) represented Vocational Education and Training (VET) and were actively engaged in Italy.

Integration of Technology

When asked to rate the integration of technologies (e.g., 3D printing, Automated Woodworking Machines) in the wood craft sector on a scale of 1-5, 80% rated it as 5 (very hight)
In order to the technological innovations or tools currently in use in the wood craft industry, 80% of stakeholders select Automated Woodworking Machines

Training Programs and Technological Innovations

95% of the respondents had participated in or offered training programs focused on integrating new technologies in the wood craft industry;
just one participated in a training activity in this matter explain that his motivation was to "develop new skills for unemployed people"

Interest in Learning Modules

For potential training courses on integrating new technologies, participants expressed interest in modules such as 3D printing technologies and equipment (90%) and 3D CAD modelling software applications (95%).

Assessment of Progress

The most part of wood craft artisans and carpenters (63.2%) declares that no formal assessment in place their progress in integrating new technologies

Perceived Impact of New Technologies

Stakeholders declare that impact of new technologies in their regional context will growth efficiency and productivity (85%) and provide a better adaptation to market demands (80%)

Current Needs Addressed by Technology Adoption

Steakeholders identified a lot of different needs fulfilled by the adoption of 3D printing and new technologies:
The development of new models
The possibility of developing new products

Being able to experiment with new production methodologies
Modelling of new products
Prototyping
Modernize production
Creation of new models
It improves efficiency and productivity
It improves the efficiency and agility of the company
Shortens lead times that slow product development processes
Rapid prototyping
Reduction of production times and costs
It allows efficient and sustainable management of resources
Additive manufacturing creates competitive advantages
It improves product and process performance
Streamlining and agility of production
It allows you to develop individual models upon customer request
In general, the use of 3D printing allows you to reduce production costs
It allows the customization of products
Simplified prototyping

Obstacles and Challenges
In order to obstacles to integrating technological innovations, 100% of respondents cited 'Limited qualified/specialized workforce,' while 85 % identified Cultural factors, resistance to change

The survey reveals a clear recognition among the participants of the importance and positive impact of integrating new technologies into the wood craft sector. However, there are significant barriers to adoption, including the cost, lack of specialized workforce, and resistance to change. There's a pronounced interest in training related to 3D printing and CAD software, suggesting a potential direction for future educational programs. Despite the enthusiasm for technology, there's a notable gap in formal training and assessment methods, highlighting an area for potential development to support the sector's evolution.

Desk Research

The desk research conducted by aims to collect and examine existing and easily obtainable information on the topic of “Enhancing traditional craft practices through 3D printing and technology innovation”, using company records, public reports, academic articles, and information found in newspapers, magazines, and on the internet.
When talking about additive manufacturing and materials, we often think of plastics or metals. However, the current offering has significantly grown over the years, and now technology allows us to create products with a wide range of materials, from ceramics to food to stem cell-laden hydrogels. Among these amazing materials is wood. Now compatible with processes such as

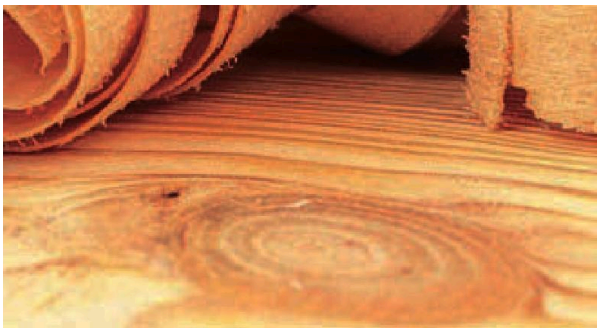
filament extrusion or even powder bed methods, wood 3D printing is becoming increasingly popular.
According to a report published by the journal Nature, humans have already lost 54% of the total number of trees on our planet. Deforestation is a real threat today, and it is crucial to rethink the way we consume wood. Additive manufacturing could be the key to a more sustainable use of wood because it is a production technique that uses only the necessary material and can design objects from recycled materials. We could, therefore, 3D print parts that would be transformed back into raw material if they are no longer useful, in order to start a new production cycle.
In Italy, the 2023 annual turnover of the wood-furniture supply chain stands at 52.6 billion euros with an overall decrease of 8.1% on 2022. Result developed mainly from the internal market at 32.7 billion euros (62% of the total) which records a negative trend (-10.1%) but which also affects exports (-4.5%) with a turnover of almost 20 billion euros (38% of the total).
In this Made in Italy cluster the artisan vocation: the 28 thousand artisan businesses represent three quarters (76.2%) of the businesses in the sector and their 86 thousand employees account for 40.4% of the sector's employment.
In addition to the traditional core skills, specific for each profile, the "Twin Transition" (Green and Digital) requires the acquisition of a set of new Skills/Knowledge/Competences relating to the professional profiles of the wooden craft artisans and carpenters.
Training and one greater attention to innovation seem be the key words to draw next scenarios of the manufacturing sector carpentry. It is the result of the investigation “The future of wood” created by Cna Toscana, in collaboration with the Cna Opera Foundation, to understand the current situation and prospects of the carpentry sector. That’s the reason because, in Italy, several companies in the wood sector are using 3D printing in their business.
Cutting-edge equipment, working methods updated to the most recent developments in the sector, certified installation, 3D printing and great attention to the environment are the ingredients of success also for wooden craft artisans and carpenters.
3d printing represent a useful way to save materials, to innovate and be competitive.
The aim of this desk research is to describe national and local context and to analyze target group’s needs and opportunities to show that technology and tradition can meet every need of designers, builders and private individuals.

Sectoral feasibility study: wood and furniture

The Sectoral Feasibility Study for the Wood and Furniture sector in Basilicata indicates a roadmap for integrating digital fabrication technologies, which can serve as a model for other regions. This approach can unlock economic growth and sustainable development opportunities.

This report is crucial for unlocking the region's potential in this industry. It provides a roadmap for sustainable development, innovation, and economic growth, benefiting not only the local communities and businesses but also contributing to the broader economy.

The key points of a feasibility study conducted in Basilicata Region named “Industria 4.0 - Regione Basilicata” aimed at identifying the state of innovation of manufacturing companies in Basilicata and the possible digital transformation plans, through digital fabrication technologies.



The adoption of 3D printing in woodcraft can lead to more sustainable practices, as this technology allows for precision in using materials, minimizing waste. It also opens the possibility of using recycled materials, contributing to a circular economy where parts can be repurposed or recycled, thus addressing concerns like deforestation.

Italy's wood-furniture sector, with a significant artisanal component, has faced challenges but also opportunities through technology adoption. The sector, which saw a decrease in turnover, shows a path for recovery and growth through innovation, underscoring the importance of training in new technologies for artisans.

The research into additive and subtractive systems reveals significant advancements in the use of wood in digital fabrication. Wood composite filaments for 3D printing and the precise assembly of wooden elements through digital design and CNC milling represent the forefront of technology integration into traditional crafts.

As far as the additive system is concerned, digital fabrication has essentially moved on two fronts:

- the creation of materials for 3D printing with a percentage of wood;
- the aggregation of wooden elements with different technologies and design approaches.

Innovations such as wood composite filaments (e.g., Laywood) and projects like the Stick Pavilion demonstrate how 3D printing technologies can adapt to wood, allowing for sustainable and creative construction and design solutions that retain a wood-like appearance and scent.

Laywood filament

While with the Subtractive System the material removal processes have been utilized, the use of wood has been significant in the realm of digital fabrication, due to the intrinsic characteristics of wood that make it suitable for this type of transformation.While 3D printing is an additive process, building objects layer by layer from the ground up, subtractive manufacturing involves starting with a solid block of material and removing material to shape the final product. In woodworking, subtractive processes are commonly carried out using CNC (Computer Numerical Control) machines, laser cutting, or milling.Subtractive Manufacturing: CNC machines, laser cutting, and milling are highlighted as precise, efficient methods for creating intricate designs and patterns in wood, ranging from small-scale objects to architectural elements. These technologies enable artisans to achieve designs that are difficult or impossible with manual techniques.

Laser cut-Epiloge

Examples of materials and tools that can be provided as a reference supporting desk research phase are:

1.- Project/Organizations reports and presentations
2.- Case studies
3.- Blogs and vlogs
4.- Press releases
5.- Websites and Social Media
6.- Company Databases and data sets

1.- Project/Organizations reports and presentations

The design approach of those involved in the creation of wooden artefacts is guided by the technical manufacturing possibilities that each realization brings, due to factors related to both

costs and the processing opportunities present in the territory and offered by companies in the sector. In light of this consideration, the design aspect assumes a fundamental character, especially if directed towards maximizing the performance of the artefact in all its aspects (functional, aesthetic, structural), through the use of processes even with limited operational freedoms.

- **The "Parametric furniture" Oleg Soroko**

  Developed by Russian designer Oleg Soroko the "Parametric furniture" project features wooden shelving and seating pieces with organic curves that seem to flow. Inspired by nature and the future, each object is made from 18 mm-thick plywood sections and fastened together with iron rods. The processing of composite sections includes different examples at various scales.

Parametric Bench - Oleg Soroko

- **Urban Bench for urban furniture made by Nadaaa.com**

Beyond those inherent to design, which has produced commendable results, as in the case of the Urban Bench for urban furniture made by Nadaaa.com that adapts its morphology to different seating positions, this technique is also noticeable in the creation of interior furniture systems. In this regard, within the woodwork carried out by a 2-axis machine, there are smaller-scale design objects such as the lamp made by Carl-Axel Acking.

Urban Bench – NADAAA

In this case, the wooden sections are slotted into two circular supports of the same material. The value of the aforementioned lamp, besides being aesthetic, is that it was constructed without the use of adhesives or other gluing systems.

- **Prototype Wood Ceiling Carl-Axel Acking**

Carl-Axel Acking; Prototype Wood Ceiling Light, 1985

Using the technique of laser cutting or milling with precision tools, small cuts are made in sheets of wood with different patterns. Once the milling is completed, the wood can be bent, in accordance with the pattern design, in both directions without breaking.

Snijlab, through this methodology, produces booklets, whose cover is a single sheet of wood cut from a birch plywood and finished with a clear varnish. Through this project, the creators have stated their intention to showcase the vast possibilities of digital production.

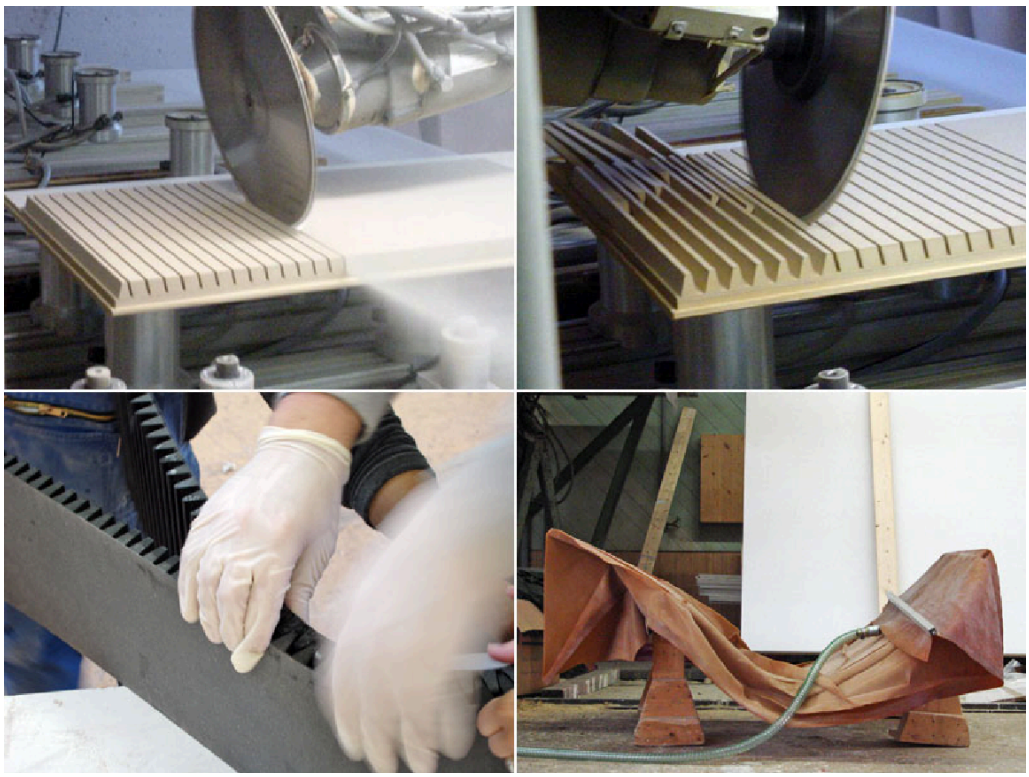
Laser Cutting on Wood - Dutch Digital

- **Wood panel processing Copenhagen School Wooden chair Copenhagen School Sectoral**

Drawing inspiration from natural phenomena, Nervous System is a generative design studio based in Somerville, Massachusetts, that engages in creation through the use of knowledge and skills at the intersection of science, art, and technology. (http://n-e-r-v-o-u-s.com/).
N-e-r-v-o-u-s S-y-s-t-e-m writes computer programs based on processes and models found in nature, which are used to create unique and economical products.
The business model chosen by the N-e-r-v-o-u-s S-y-s-t-e-m group to position itself in the market represents a new paradigm where designers personally reach the production phase, dissolving the margins of their specific skills and acquiring others, both of a purely technical nature and of a commercial nature.
This model is one of the most immediate consequences of the impact of digital technology on manufacturing production, supported by the horizontal thrust of production systems and open knowledge.
Following the same line of the processes performed to give wood an additional degree of flexibility, discussed in the "2.5 Axes" section, it is worth mentioning the result achieved by participants in the workshop organized by the School of Architecture and Design in Copenhagen using the flexibility of an additional degree of processing.

The laboratory experience aimed to investigate the consequences of digital fabrication on wood construction, with a particular focus on the logic and possibilities of the joint element. The starting point of the workshop activity was to interpret the production of a manufactured item

Copenhagen School chair processingas a process composed of different flows of matter, energy, and information that come together, from the beginning, in the realization of the product.
The attention paid to these design aspects is fully expressed in the prototype of the chair created at the end of the research experience, where it was also studied how computational design can create a new understanding and offer new possibilities to the constructive practice of wooden elements, from the combination of customized details to new production techniques, as well as the activation and control of material properties.
The most difficult part to optimize during the chair design process was calculating the tolerance that the two wooden panels had to have between them so that, once assembled, they could bend to form the seat.

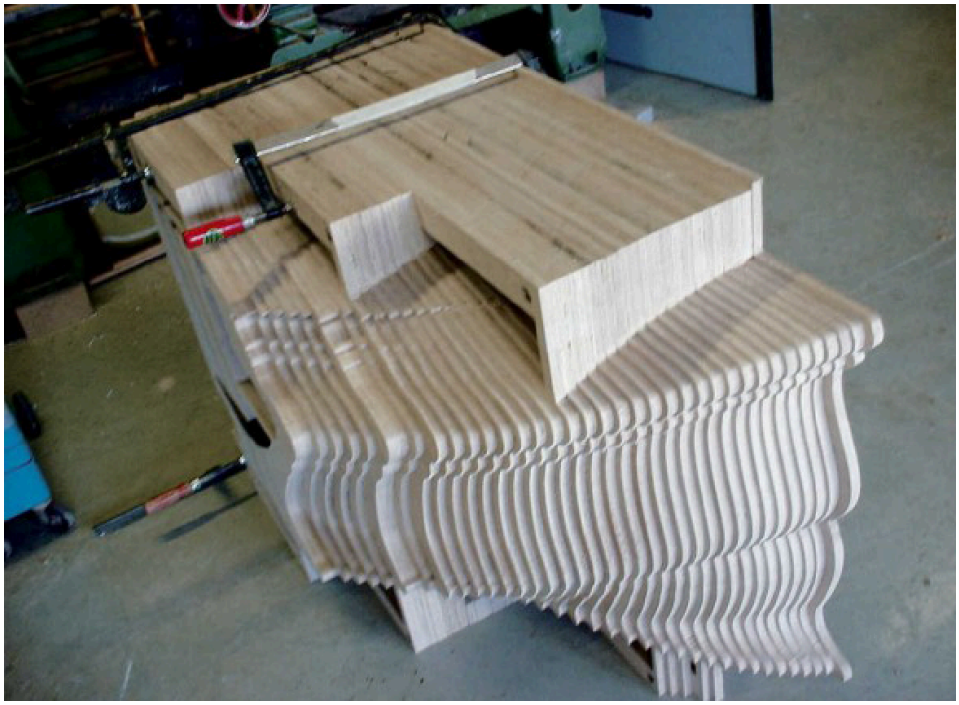


Chair processing Copenhagen School

- **Cindarella Table Jeoren Verhoeven**

An example of the exacerbation of assembly-based processing is the "Cinderella Table" created by designer Jeroen Verhoeven, a reinterpretation of Dutch design traditions through the means of modern technology.
The table is always digitally designed Jeroen Verhoeven is a Dutch designer who attended the Design Academy Eindhoven.
Gluing system Cinderella Table and the files that describe it in two dimensions on the computer are the same ones used to control the machines that define its sections. Since human

intervention, as well as the sensitivity of a designer/craftsman, are omitted from the material realization of the table, in favor of error-free mechanical processes, it would seem that CAD/CAM processes deny the individualism of handmade objects.
However, Verhoeven wanted to use CAD/CAM as a "new modern craft" because he felt that it "hid a craftsmanship" within it.



Cinderella Table Gluing System

For the design of the table, Verhoeven was inspired by 17th and 18th-century shapes, archetypes of tables and chests he found in the library of the Stedelijk Museum in Amsterdam, considering this period as the pinnacle of artisanal furniture.
By simplifying the contours of these furnishings and merging them together through computer work, he created a fluid three-dimensional shape.
The realization of the table took three months of work. The virtual design was the classic "slices" method, each 80 mm for a total of 57 slices (it took 741 layers of plywood).

Cindarella Table Jeoren Verhoeve

2.- Case studies

- **Falegnameria Colacicco (Matera)**

In 2002 it was decided to invest in technology by purchasing a C.N.C. in order to facilitate the production process, thus resulting in the specialization in the use of Alphacam CAD/CAM software. In 2009 he joined the board of directors of the upholstered furniture district of Matera and deals with innovation and technology. In 2011 he followed the MiM project in collaboration with the Polytechnic of Milan, attended a training course together with other artisans and designers on the applications of Design in the upholstered furniture sector, participating until the creation of a "Melissa" armchair prototype which will be exhibited together with objects by well-known designers from the Triennale di Milano collection.

In 2014/2016 a research collaboration began with the partner Area Scienze Parck of Trieste and the University of Basilicata for technology transfer to businesses. Involved in the "Fadibas" project for digital manufacturing in artisan businesses where the objective was to use existing machines and convert the use through the use of digital, also protagonist at the universal exhibition at Expo 2015. In 2015/16, participation in the Tent fair in London together with the "CasaMatera" network with the exhibition of two tables with three-dimensional surfaces made of wood.

In 2017 collaboration with Open designe school project of Matera Capital of Culture 2019 - “Digital Materia” project, experimentation on three-dimensional workings on tuff in collaboration with the Bartlett school of architecture in London. In October he took part in the world Maker Fair event in Rome, hosted at the CAD stand (Cava de Tirreni Digital Crafts School), obtaining enough interest to receive a special "Maker of merit" mention.

Selected with the project "The stamps of bread 4.0 in the theoretical, historical and critical research category to compete for the most prestigious award in Italian design" Compasso D'oro organized by ADI design. Important realization of a project shared with the architect. Nico Colucci of a “Tattile” table at the Infermi Children's Hospital in Rimini. Creation of the goose

game (GOOSE) for the square and the table in collaboration with the equality councilor of the province of Potenza Simona Bonito.

Guest of the Medaarch Space at the most important innovation fair Maker Faire ROMA 2023

https://www.falegnameriacolacicco.it/

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4. BIC Innobridge - Bulgaria

Introduction

As of 2024, the 3D printing technology in Bulgaria is in its infancy, when it comes to practical industry implementation. Most of the time the technology is used by enthusiasts and educational institutions, although there are some small businesses that are producing souvenirs and small gadgets with 3D printers.

While Bulgaria's specific contributions to and benefits from this technological advancement are not detailed in available resources, the involvement of Bulgarian companies (for example -

easy3D) in the broader European market highlights the country's engagement with 3D printing technology. The continued growth and investment in the sector across Europe suggest a favorable environment for the expansion and deeper integration of 3D printing technologies in Bulgaria's industrial landscape.
In this desk research, we have tried to compile a set of investigations among the target groups, in order to gain insight of the sector and its future plans.

Best Practice 1

Best Practice title: VET School of Woodworking and Interior Architecture “Joseph Vondrak”, and 3D printing technologies slowly entering the curriculum

Project partner: BIC Innobridge

Topic	
Best practice Title	VET School of Woodworking and Interior Architecture “Joseph Vondrak”, and 3D printing technologies slowly entering the curriculum
Keywords	Vocational Education and Training (VET), traditional craft practices, carpentry, wood crafts, woodworking, craftsmen, skill enhancement, innovation, collaborative learning, industry-integrated curriculum, apprenticeships, 3D printing technologies, integration.
Best practice The vocational school of Woodworking and Interior Architecture “Joseph Vondrak” offers a broad	

variety of specialities, such as “Interior design”, “Furniture manufacturing”, “Polygraphy”, “Spatial Design” and “Artistic wood carving”. Although 3D printing technologies haven’t been integrated into the school's curriculum yet, students from the school take part in many events and competitions where they can show off their artistic wood works, and win prestigious places. Currently, part of the graduates continue their studies at university, while others find good realization, starting work in furniture companies. Recently, students from the speciality “Interior design” participated in an event called “Wooden ‘Zoo’”, where with a lot of diligence and application of what they learned in class, they carved, painted and made wooden chairs, with animals and favourite cartoon characters for children, using a 3D printer. Last year, the school held a Christmas bazaar, where students from the specialities "Interior Design", "Furniture Production", "Polygraphy" and "Artistic Carving" presented their products. The bazaar offers Ruse residents a variety of wooden toys, candle holders, handmade cards and trees, Christmas decorations and gifts for all ages. People always stop by the stand with the products because of the mood with which the high school students present their works and motivate everyone to make their choice with them. 3D printing technologies could greatly enhance events like this by offering more diverse and customizable products. Imagine if alongside the traditional handmade crafts, there were also intricately designed 3D-printed ornaments, personalized gifts, or even prototypes of furniture and interior decorations. These technologies enable rapid prototyping and customization, allowing artisans and designers to experiment with new ideas and cater to individual preferences more efficiently. Additionally, 3D printing can contribute to sustainability by using eco-friendly materials and minimizing waste in the production process. Introducing 3D printing into such events could not only enrich the variety of offerings but also inspire creativity and innovation among students and attendees alike.	
Reference Link (if any)	http://pgdva-ruse.net/ https://ruo-ruse.bg/%D0%B4%D1%8A%D1%80%D0%B2%D0%B5%D0%BD-%D0%B7%D0%BE%D0%BE%D0%BA%D1%8A%D1%82-%D0%B2-%D0%BF%D0%B3%D0%B4%D0%B2%D0%B0-%D0%B9%D0%BE%D1%81%D0%B8%D1%84-%D0%B2%D0%BE%D0%BD%D0%B4%D1%80/ https://www.dunavmost.com/novini/gimnaziyata-po-darvoobrabotvane-v-ruse-otkri-koleden-blagotvoritelen-bazar
Provided By	*- Name of the Institution/Partner that implemented the practice:* BIC Innobridge *- Contact of the Institution/Partner (name, email, telephone):* Lora Dimitrova (ldimitrova@innobridge.org) Nikolay Tsolev (ntsolev@innobridge.org) *- Name of the Strategy/Programme:* Erasmus+

	- Other useful information (if any):
Language	ENGLISH

Best Practice 2

Best Practice title: Developing broad range of skills with 3D printing technologies

Project partner: BIC Innobridge

Topic	
Best practice Title	Developing broad range of skills with 3D printing technologies
Keywords	new skills, introduction to 3D printing, 3D printing technologies, integration, university, skill enhancement, innovation, collaborative learning, industry-integrated curriculum.

Best practice

The Department of Telecommunications in the University of Ruse has modern equipped laboratories. The faculty of the department always strives to update the facilities so that they can adequately meet the topics covered in the curriculum. The department has several types of 3D printers that allow the creation of real 3D models.

During the COVID-19 pandemic, the University of Ruse urgently began to produce, with the help of 3D printers, protective helmets for the country's medical workers, as well as parts for breathing apparatuses needed by coronavirus patients. This experience serves as a catalyst for further exploration and utilization of 3D printing in various sectors.

In addition to its applications in fields like healthcare and manufacturing, 3D printing is poised to revolutionize traditional practices in woodworking and carpentry, offering new avenues for creativity, efficiency, and sustainability. The integration of 3D printing technology within the University of Ruse's laboratories can catalyze innovation in these sectors as well.
Woodworking and carpentry traditionally rely on manual craftsmanship and precise measurements to create intricate designs and functional structures. While these skills are invaluable, 3D printing introduces a complementary toolset that expands the possibilities of what can be achieved.

Moreover, 3D printing opens up new opportunities for the creation of complex geometries and intricate patterns that would be challenging or impossible to achieve with traditional woodworking techniques

alone. By integrating 3D printed components into woodworking projects, artisans can add unique decorative elements or functional features that elevate the aesthetic appeal and functionality of their creations.	
Reference Link (if any)	https://www.uni-ruse.bg/Departments/Telekomunikatsii/facilities https://digitalk.bg/new_technologies/2020/03/21/4044212_rusenskiiat_universitet_shte_otpechatva_na_3d_printeri/ https://www.uni-ruse.bg/Departments/Telekomunikatsii/news https://bntnews.bg/news/rusenskiyat-universitet-proizvezhda-chasti-za-obdishvashti-aparati-s-3d-printer-1045387news.html
Provided By	*- Name of the Institution/Partner that implemented the practice:* BIC Innobridge *- Contact of the Institution/Partner (name, email, telephone):* Lora Dimitrova (ldimitrova@innobridge.org) Nikolay Tsolev (ntsolev@innobridge.org) *- Name of the Strategy/Programme:* Erasmus+ *- Other useful information (if any):*
Language	ENGLISH

Best Practice 3

Best Practice title: Restoring old wood furniture with 3D printers

Project partner: BIC Innobridge

Topic	
Best practice Title	Restoring old wood furniture with 3D printers

Keywords	Furniture restoration, 3d printing, 3d printing workshops, 3d printing courses

Best practice

Delcho Delchev is an architect by education and one of the founders of the famous group “Transformers”. Subsequently, he retired in order to embark on the creation of a Bulgarian branch of the international chain Smart Fab Lab - the first shared workshop in Bulgaria, part of the global Fab Lab network. In the incubator of the Smart Fab Lab, interesting startup ideas and products are born, some of which have already been brought to mass production.

The initiative they are creating aims to teach people how to breathe life into old furniture with the help of 3D printing. Delchev, who is the main instructor in the educational courses, shares his own experience and inspiration, starting with a simple damaged coat hanger, which he had the idea to reconstruct with 3D printing. From that idea emerged the concept for the larger initiative, engaging with the wider public via seminars, educational courses and demonstrations. The organization started with small courses for using modern technologies to restore household items, furniture and others.

Currently, the FabLab workshops are popular in several countries in Europe, organizing seminars and workshops with enthusiasts and young people, willing to learn more about not only the new technologies but also how they can use them to preserve the cultural heritage.

Reference Link (if any)	https://vijmag.bg/bg/article/noviyat-3d-starite-mebeli https://smartfablab.org/en/fab-lab https://darik.bg/vav-vtoria-klas-na-melba-uchiliste-delcho-delchev-ste-pokazva-kak-se-popravat-mebeli-s-3d-printirane
Provided By	*- Name of the Institution/Partner that implemented the practice:* BIC Innobridge *- Contact of the Institution/Partner (name, email, telephone):* Lora Dimitrova (ldimitrova@innobridge.org) Nikolay Tsolev (ntsolev@innobridge.org) *- Name of the Strategy/Programme:* Erasmus+ *- Other useful information (if any):*

Language	ENGLISH

Best Practice 4

Best Practice title: Overview of the wood crafting practices in Bulgaria

Project partner: BIC Innobridge

Topic	
Best practice Title	Overview of the wood crafting practices in Bulgaria
Keywords	3D printing, traditional craft practices, carpentry, wood crafts, woodworking, technologies, innovation.

Best practice

Carpentry and woodcraft in Bulgaria have a deep-seated heritage rooted in generations of traditional skills, spanning carving, joinery, turning, and finishing. These crafts are integral to Bulgarian culture, crafting functional items and architectural marvels from locally sourced timber. Each region boasts distinct woodworking traditions; for instance, the Rhodope Mountains are famed for intricate carvings. Bulgarian artisans create different kinds of items, from furniture to religious icons, featuring intricate designs inspired by folklore.

Some of the oldest monuments of woodcarving in Bulgaria come from the 13th – 14th century. But the highest point of its development, the wood carving obtained during the Bulgarian Renaissance, when the increased national pride and wealth have been expressed in the rich decoration of houses, office buildings, churches and monasteries.

Internationally prized for their craftsmanship, Bulgarian woodworking products enjoy growing demand abroad. Amidst a comeback of interest in traditional techniques, artisans blend age-old skills with modern tools and design, ensuring their relevance in contemporary markets. Efforts to preserve and promote these skills through education and cultural initiatives seek to safeguard Bulgaria's woodworking legacy for future generations.

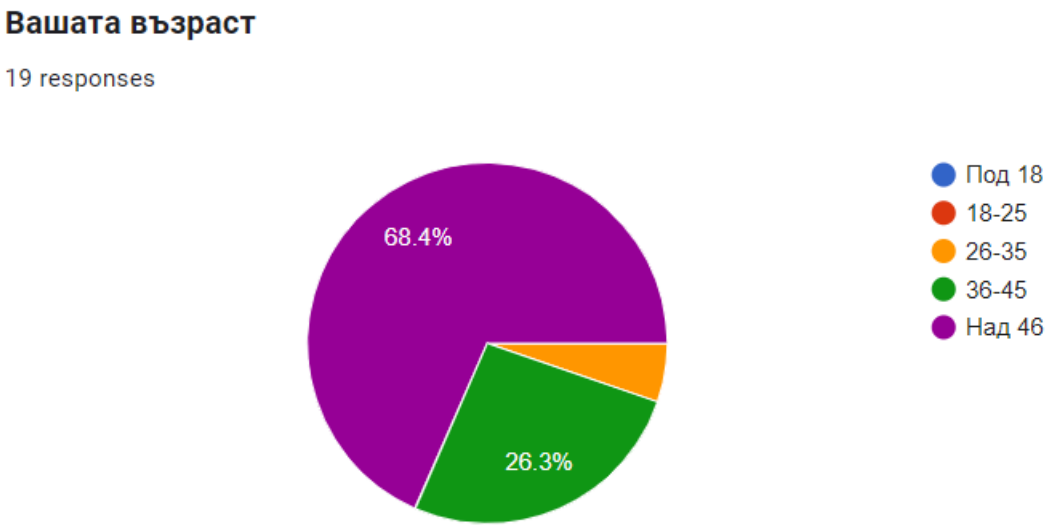
However, there are almost no technological innovations regarding 3D printing in the wood-cutting sector, since most people practising them are elderly people, who stick to the traditional ways. Based on the rich history of woodcarving, especially the iconostasis (carving of traditional orthodox icons), working in the sector is very conservative and resilient to change. Old craftsmen take pride in their use of traditional technologies and tools and work mainly by hand. The introduction of 3D printing in this particular sector is not considered a viable option, except for modern manufacturers or furniture

building or repair. Last but not least, this sector has had little to no 3D printing integrations throughout the years, with some innovations from NGOs and mostly project-based events.	
Reference Link (if any)	https://www.bulgarkamagazine.com/%D0%BD%D0%B0%D1%80%D0%BE%D0%B4%D0%BD%D0%B8%D1%82%D0%B5-%D0%B7%D0%B0%D0%BD%D0%B0%D1%8F%D1%82%D0%B8-%D1%81%D0%B8%D0%BC%D0%B2%D0%BE%D0%BB%D0%B8-%D0%BD%D0%B0-%D1%82%D1%80%D1%83%D0%B4%D0%BE%D0%BB%D1%8E/ https://woodcraftbg.wordpress.com/ https://bulgariatravel.org/wp-content/uploads/2016/publication_5869_1.pdf
Provided By	*- Name of the Institution/Partner that implemented the practice:* BIC Innobridge *- Contact of the Institution/Partner (name, email, telephone):* Lora Dimitrova (ldimitrova@innobridge.org) Nikolay Tsolev (ntsolev@innobridge.org) *- Name of the Strategy/Programme:* Erasmus+ *- Other useful information (if any):*
Language	ENGLISH

Survey and Focus Group

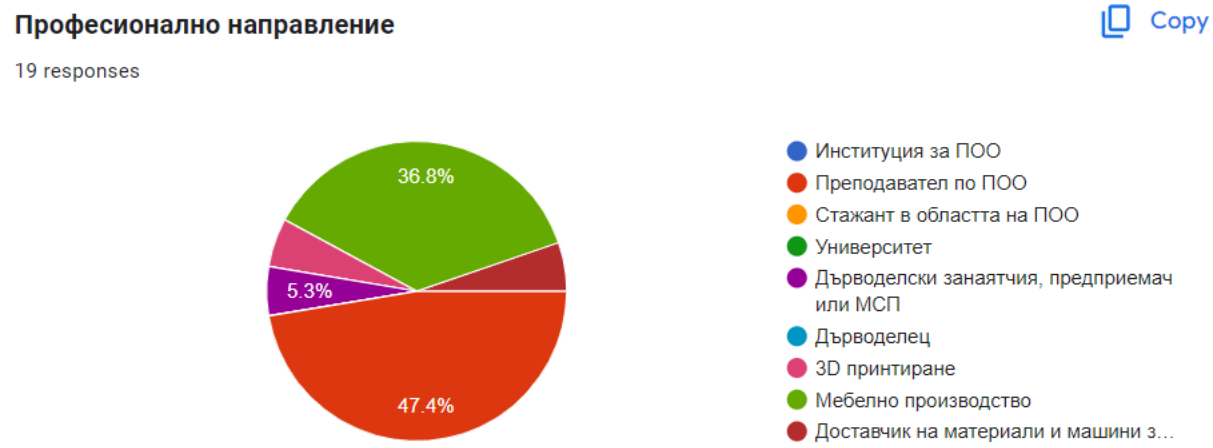
0. Demographic data

A. Age



As expected, the majority of respondents were above 46 years of age (13 people), the rest being 36-45 years (5) and one respondent in the 26-35 age bracket.

B. Occupational field

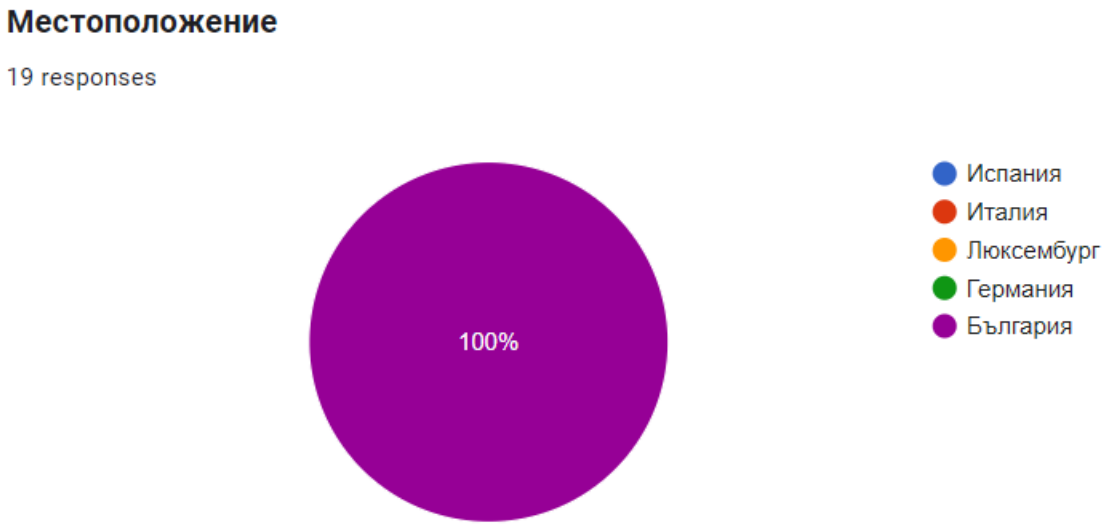


The received answers are the following

- VET institution trainer: 0 (0%)
- VET teacher: 9 (47.4%)
- VET trainee: 0 (0%)
- University teacher: 0 (0%)
- Wood Craft Artisan: 1 (5.3%)
- Carpenter: 0 (0%)
- 3D printing entrepreneur: 1 (5.3%)
- Furniture manufacturer 7 (36.8%)
- Other: 1 (5.3%)

P.A.: For the sector “Other” one answer was “Distributor of machinery and supplies for the woodworking industry”

C. Location



All respondents are located in Bulgaria

1. State-of-the-Art of technology in the wood craft sector

A. Based on your own experience, on a scale of 1-5, how would you rate the integration of technologies (i.e. 3D printing, Automated Woodworking Machines…) in the wood craft industry?

The received answers are the following

- 1: 1 (5.3%)
- 2: 3 (15.8%)
- 3: 9 (47.4%)
- 4: 5 (26.3%)
- 5: 1 (5.3%)

B. Based on your own experience, which of the following technological innovations or tools are currently in use in the wood craft industry? (Select all that apply)

The received answers are the following

- 3D Printing: 1
- CNC Machines: 13
- Augmented Reality (AR): 0
- Virtual Reality (VR): 0
- Automated Woodworking Machines: 13
- None of the above: 1

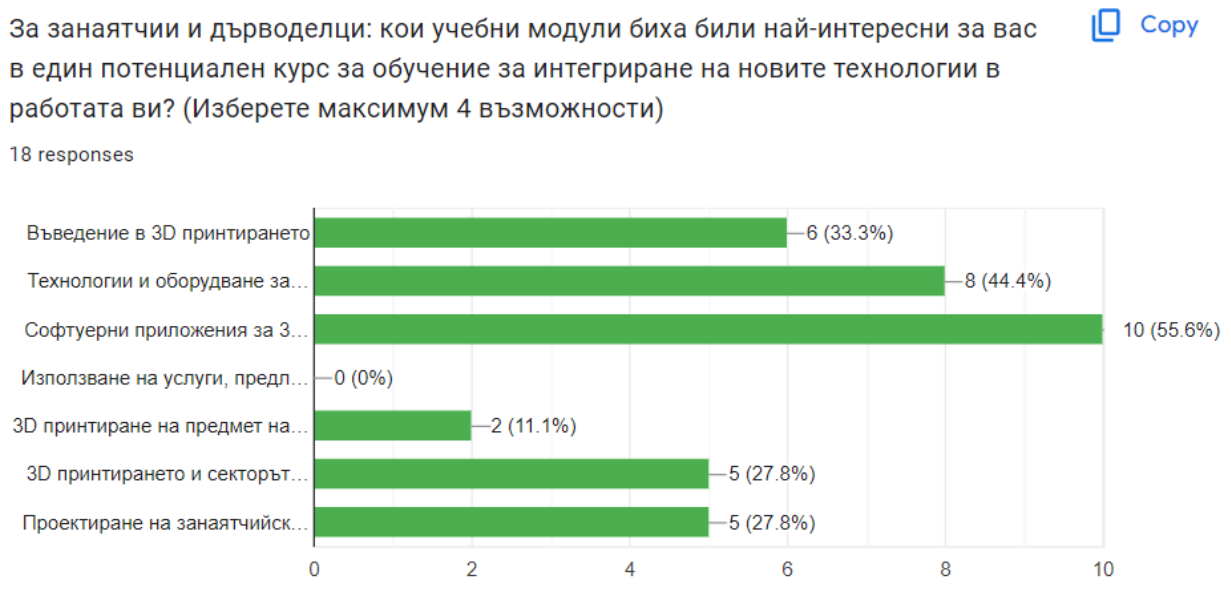
C. Have you ever participated in, or offered any training programs focused on the integration of new technologies in the wood craft industry?

Only one respondent noted that they have participated in a relevant training.

D. If yes, what were your motivations and expectations?

No answer on this question

E. For wood craft artisans and carpenters: in a potential training course for integrating new technologies into your work, what learning modules would be the most interesting for you? (Select max 4 options)



The received answers are the following

- Introduction to 3D printing: 6 (33.3%)
- 3D printing technologies and equipment: 8 (44.4%)
- 3D CAD modelling software applications: 10 (55.6%)
- Use services offered by 3D printing providers to obtain physical models: 0 (0%)
- 3D printing an object on a low-cost filament deposition-based printer: 2 (11.1%)
- 3D printing and the wood craft sector: 5 (27.8%)
- Design a wood craft object with 3D printing in mind: 5 (27.8%)

F. For wood craft artisans and carpenters: how do you assess your progress in integrating new technologies into your activity?

The received answers are the following

- Regularly attend workshops and training sessions: 11 (61.1%)
- Self-assessment based on practical application: 3 (16.7%)
- Peer reviews and feedback: 0 (0%)
- No formal assessment in place: 4 (22.2%)
- Other: 0 (0%)

For context, many of the furniture companies in Bulgaria have their own training centers, and employees are regularly trained in new skills or refreshing old ones.

G. How do you think new technologies can impact the wood craft sector in your regional context?

The received answers are the following

- Enhanced craftsmanship and product quality: 7 (36.8%)
- Increased efficiency and productivity: 13 (68.4%)
- Better adaptation to market demands: 3 (15.8%)
- Limited impact: 1 (5.3%)
- Other: 0 (0%)

H. From your point of view, what current needs could be fulfilled thanks to the adoption of 3D printing and other new technologies in the wood craft sector?

With the exception of blank responses, the relevant answers were:

1. Lack of qualified workers
2. Manufacturing of innovative and modern furniture
3. Improving manufacturing time and quality
4. Improved efficiency and reducing costs
5. Improved efficiency in furniture manufacturing
6. Fast manufacturing of complex items
7. None
8. I'm not sure / I don't know / I don't have relevant observations

I. *What obstacles or challenges do you identify in integrating technological innovations in the wood craft sector in your regional context? (Select all that apply)*

The received answers are the following

- Limited qualified/specialized workforce: 8 (42.1%)
- Lack of access to technology: 3 (15.8%)
- High implementation costs: 15 (78.9%)
- Limited training opportunities: 4 (21.1%)
- Cultural factors, resistance to change: 2 (10.5%)

2. Conclusion

J. *Thank you for completing the questionnaire. Your insights will contribute to the development of tools and resources tailored to the needs of wood craft artisans and carpenters in Europe. If you have any further comments or suggestions, please feel free to share.*

No relevant answers in this question

Desk Research

Overview of the wood crafting practices in Bulgaria and 3D technology propagation

Carpentry and woodcraft in Bulgaria have a deep-seated heritage rooted in generations of traditional skills, spanning carving, joinery, turning, and finishing. These crafts are integral to Bulgarian culture, crafting functional items and architectural marvels from locally sourced timber. Each region boasts distinct woodworking traditions; for instance, the Rhodope Mountains are famed for intricate carvings. Bulgarian artisans create different kinds of items, from furniture to religious icons, featuring intricate designs inspired by folklore.

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Last but not least, this sector has had little to no 3D printing integrations throughout the years, with some innovations from NGOs and mostly project-based events.

One exception, where 3D printing is fastly gaining traction, is the healthcare sector in the country. The healthcare sector in Bulgaria is actually experiencing a rise in the application of 3D printing. High incidences of dental and orthopaedic diseases, easy development of customised medical products using 3D printing, availability of advanced 3D printing materials for dental and

medical applications, and rising demand for 3D-printed goods in the cosmetics and pharmaceutical industries are the main drivers of the market's growth.

5. AMBIT - Spain

Introduction

In Spain there are many examples of companies that today are dedicated to 3D printing. But few manufacturers or craftspeople of furniture, who use 3D printing. There are companies that print externally, due to many not have the machines to do it in their own company.
Today, 3D printing is a technology that any company can learn to use on a daily basis, to innovate, save costs and be more competitive.
Anyone can access 3D printing technology, to be able to use it in the company, with a very high rate of benefit in innovation and competitiveness.

Best Practice 1

Best Practice title: Use of 3D to save time between the designer and the craftsman, to create a handmade spoon (Valenti Garcia, Spain).

Project partner: AMBIT - Living Spaces Cluster

Topic	3D printing for prototyping
Best practice Title	**Use of 3D to save time between the designer and the craftsman, to create a handmade spoon (Valenti Garcia, Spain).**
Keywords	*design 3D, printing of prototypes, special spoon, custom pieces, artisan, craftsman*
Best practice: Use of 3D to save time between the designer and the craftsman, to create a handmade spoon, customized for restaurants.	
Valenti Garcia, industrial designer and Manolo the artisan. From the draft design to printing design and from handmade spoon to restaurant. The industrial designer was commissioned to design and present a handmade wooden spoon for a restaurant. A Spanish restaurant, with 3 michelin stars, was going to open another restaurant outside	

of Spain, in London. And he needed a typical Mediterranean identity for his dishes, to create a modern but handmade olive wood spoon.

The designer made several drawings and finally a couple of samples in 3D printing, with these samples, he went to an artisan of the olive wood work by hand, with manual lathes, taking advantage of the wood of the olive trees when has been realized the prune, and thanks to having the samples in 3D printing, the craftsman and the designer were able to have a clear idea of what the final product would look like.

These spoons can currently be found in London's ARROS QD restaurant (by Spanish chef Quique Dacosta with seven Michelin stars).

They are handmade olive wood spoons, with the name of the restaurant laser-engraved. This spoon accompanies the restaurant's paellas when they are served, as a curious detail of the traditional Valencian paella, because in the past people ate it with wooden spoons, which people often made with the remains of the olive tree with which they made the fire for cooking This spoon makes a nod to tradition, accompanying the "paella".

An example of how the project could be done with limited time thanks to the union of 3D design - 3D printing and wood craftsmanship.

Reference Link (if any)	https://www.linkedin.com/in/valenti-garcia-86621818/
Provided By	- *Valentí Garcia Design* *+34 676 991 913, valendsg@gmail.com* *- Name of the Strategy/Programme: QD Spoon Design* *- Other useful information (if any): -*
Language	ENGLISH

Best Practice 2

Best Practice title: Use of 3D printing to improve products and showcase innovative design pieces in office furniture (ARTIS, Spain).

Project partner: AMBIT - Living Spaces Cluster

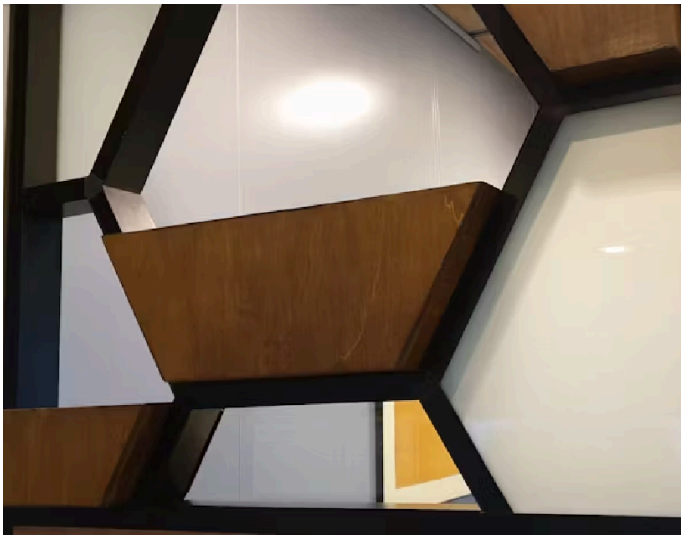
Topic	3D printing for final products
Best practice Title	**Use of 3D printing to improve products and showcase innovative design pieces in office furniture (ARTIS, Spain).**
Keywords	*furniture, offices, partitions, unique furniture, prototypes, personalized design, printing design*
Best practice: *Use of 3D printing to improve products and showcase innovative design pieces in office furniture.*	
A 3D printed piece for final use, by the company INTECH3D (From Lleida, Spain), for Artis Arquitectura Interior (Flat by Artis, Lleida and Barcelona), in the production of the part of this office divider, this portable furniture, is based on 3D for the creation of unique, personalized and limited edition pieces, leaving behind the long production chains. 3D printers provide the possibility of converting traditional work methods, improving quality in final products and competitiveness with price and production time.	

The partner INTECH3D realized the 3D pieces: The most important applications in the furniture sector carried out by INTECH3D are industrial prototyping, the manufacture of end-use parts and sculpture.

In the world of furniture, when products are made with an initial production at a prototype level, 3D printing can be used to make prototypes for final use, these prototypes being part of the final product, becoming part of 3D printing of the production phases. This technique makes it possible for the time or resources used in special series or models to form part of a manufacturing productivity and efficiency strategy, as well as customization for the end user.

Analyzing the collaboration of INTECH3D with the office furniture producing company, they show us effectiveness in the use of innovative technologies in the furniture sector, such as 3D printing, whether in hardware, final pieces, prototypes or customizations, among others.

These companies have been taken as an example, due to the innovation of both in the use of prototypes made in 3D printing in final products.



Reference Link (if any)	https://intech3d.es/aplicacion-impresion3d-sector-mobiliario/ https://www.artis.es/es/arquitectura-interior/
Provided By	- *INTECH 2015, SL printing for* *+34 973 982 351, info@intech3d.es* *- Name of the Strategy/Programme: Flat Move (Flat MOVE | Artis)* *- Other useful information (if any): -*

Language	ENGLISH

Best Practice 3

Best Practice title: Use of 3D to carry out physical prototyping of furniture hardware, special handles or personalized pieces (BUSTPER & VANDISS, Spain).

Project partner: AMBIT - Living Spaces Cluster

Topic	3D printing for prototyping
Best practice Title	**Use of 3D to carry out physical prototyping of furniture hardware, special handles or personalized pieces (BUSTPER & VANDISS, Spain).**
Keywords	*printing 3D, design 3D, printing of furniture hardware, special handles, custom 3D pieces, personalized, prototypes.*

Best practice: Use of 3D to carry out physical prototyping of furniture hardware, special handles or personalized pieces. It is done in 3D to see the final finish, use and to be able to validate it, if anything, before doing it in other more expensive and complex materials.

BUSTPER is a furniture manufacturer of South of Catalonia (Spain) in La Sénia, and VANDISS from Amposta, near La Sénia.

The BUSTPER company occasionally makes 3D prints to quickly see prototypes, real volumetric control of parts, design of custom hardware or handles, as well as final prototypes of special parts or customizations.

Together with VANDISS, several 3D prints have been made to validate the design of -for example- special wooden designs for contract-hospitality, personalized handles for folding canapés, cabinet handles (to validate their manufacture in metal or not), special personalized hardware for special clients, etc.

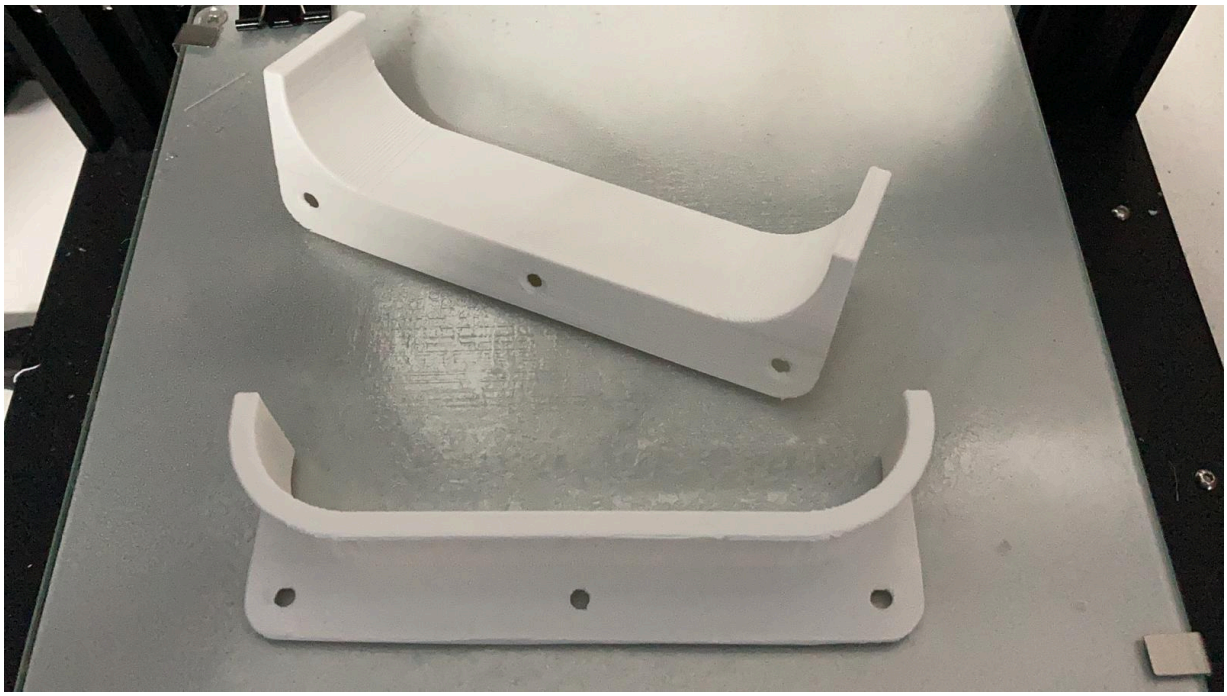
We have observed that being able to use 3D printing in companies in the furniture sector allows them to access this technology for rapid prototyping or manufacturing personalized products, in an economical way compared to other technologies.

For a special client, a personalized hardware design was made, and several 3D printed samples were made, in less than 34 hours, to validate its use and acceptance by the client, so that it would be a personalized and recyclable piece, but in the end the client opted for metal hardware. 3D printing made it possible to present different prototypes to the client, in order to opt for a personalized piece or the standard one on the market. 3D printing allowed us to be productive and present the designer's drawing to the 3D piece to the client, in a very short time.

The use of 3D technology in the furniture sector is positively valued, to be able to carry out small manufacturing lines, or specific customizations, in a way accessible to small companies.

Even the possibility of acquiring your own 3D printing machine in the future.

This is how we see in BUSTPER and other companies in the sector, the use of 3D to carry out physical prototyping of furniture hardware, special handles or personalized pieces. It is done in 3D to see the final finish, use and to be able to validate it, if anything, before doing it in other more expensive and complex materials.



Reference Link (if any)	https://www.bustper.com/ http://vandiss.com/
Provided By	- *VANDISS Design edition printing for BUSTPER* *+34 613 008 540 - 676 991 913, info@vandiss.com* *- Name of the Strategy/Programme: 3dcreativesolutions*

	- Other useful information (if any):-
Language	ENGLISH

Survey and Focus Group

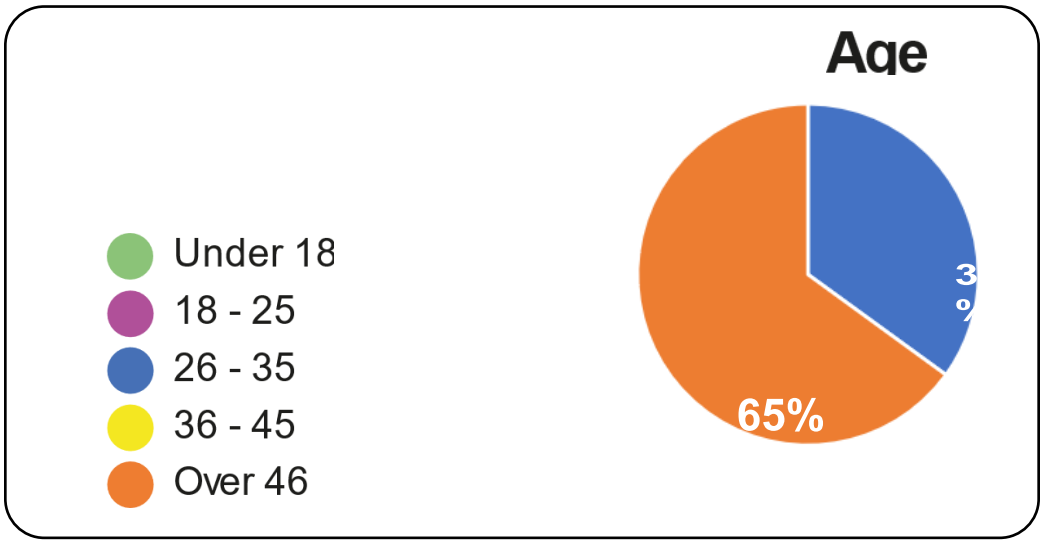
1. Demographic data

2.1. Age

20 answers

The received answers are the following:

- Under 18: 0 (0%)
- 18-25: 0 (0%)
- 26-35: 7 (35%
- 36-45: 0 (0%)
- Over 46: 13 (65%)

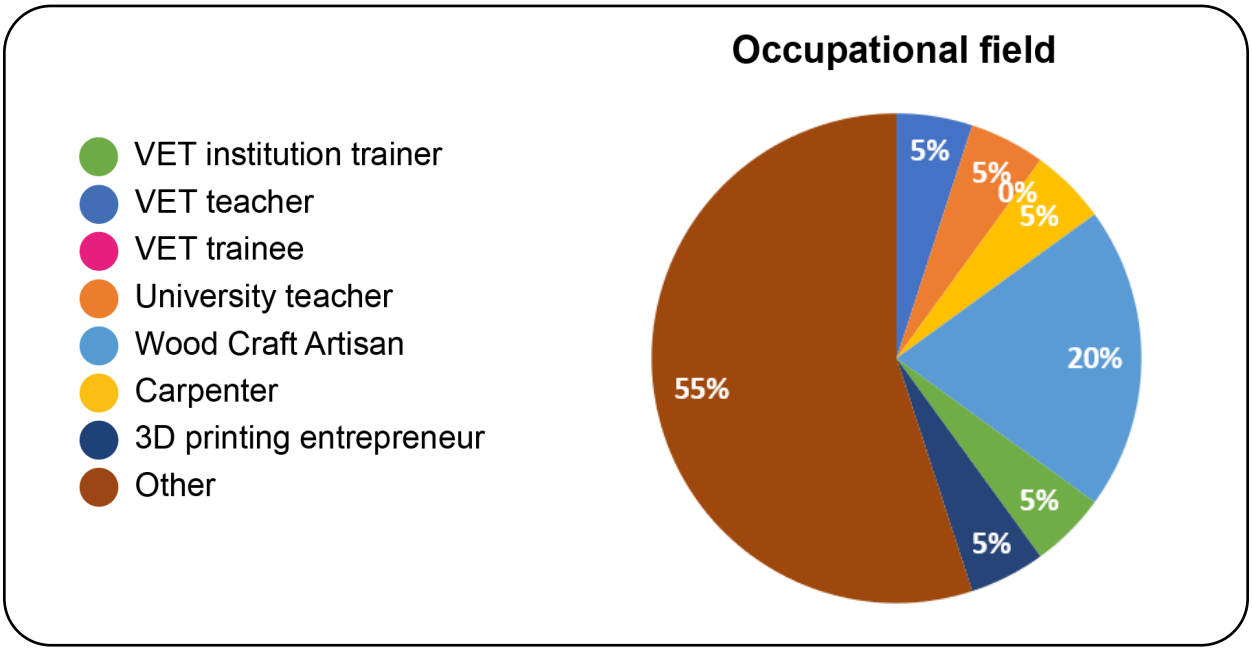


2.2. Occupational field

20 answers

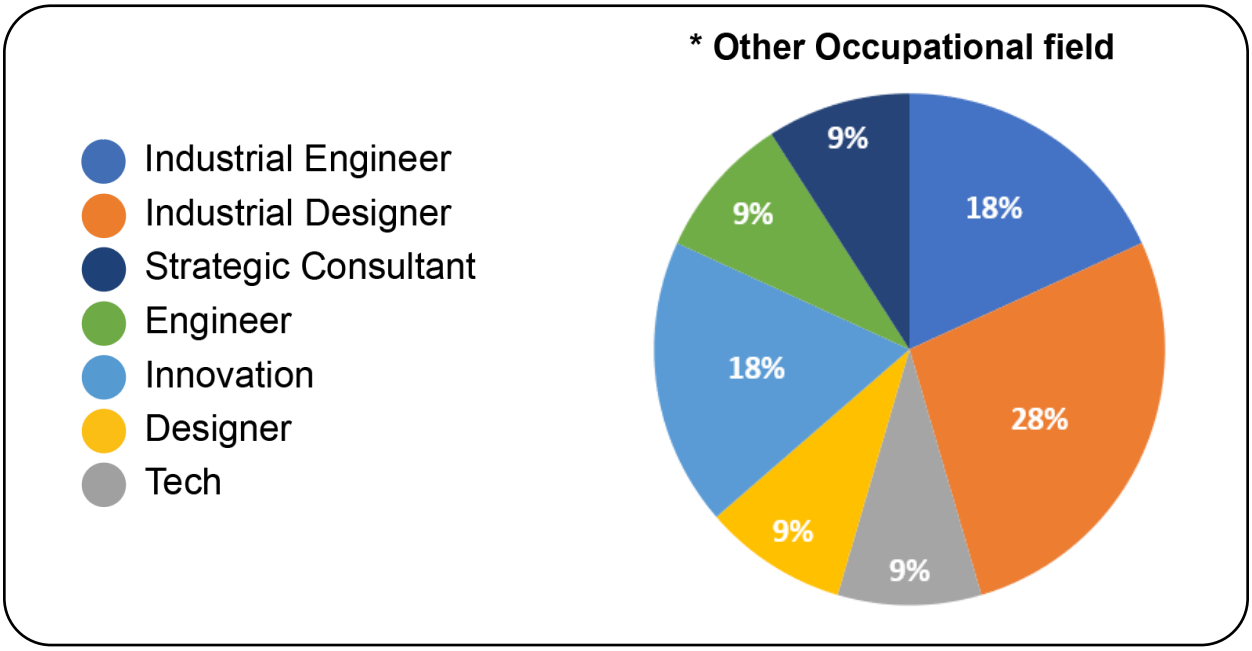
The received answers are the following:

- VET institution trainer: 1 (5%)
- VET teacher: 1 (5%)
- VET trainee: 0 (0%)
- University teacher: 1 (5%)
- Wood Craft Artisan: 4 (20%)
- Carpenter: 1 (0%)
- 3D printing entrepreneur: 1 (5%)
- Other *: 11 (55%)



* For the Sector “Other” (11 people):

- Industrial Engineer: 2 (18%)
- Industrial Designer: 3 (28%)
- Strategic Consultant: 1 (9%)
- Engineer: 1 (9%)
- Innovation: 2 (18%)
- Designer: 1 (9%)
- Tech: 1 (9%)

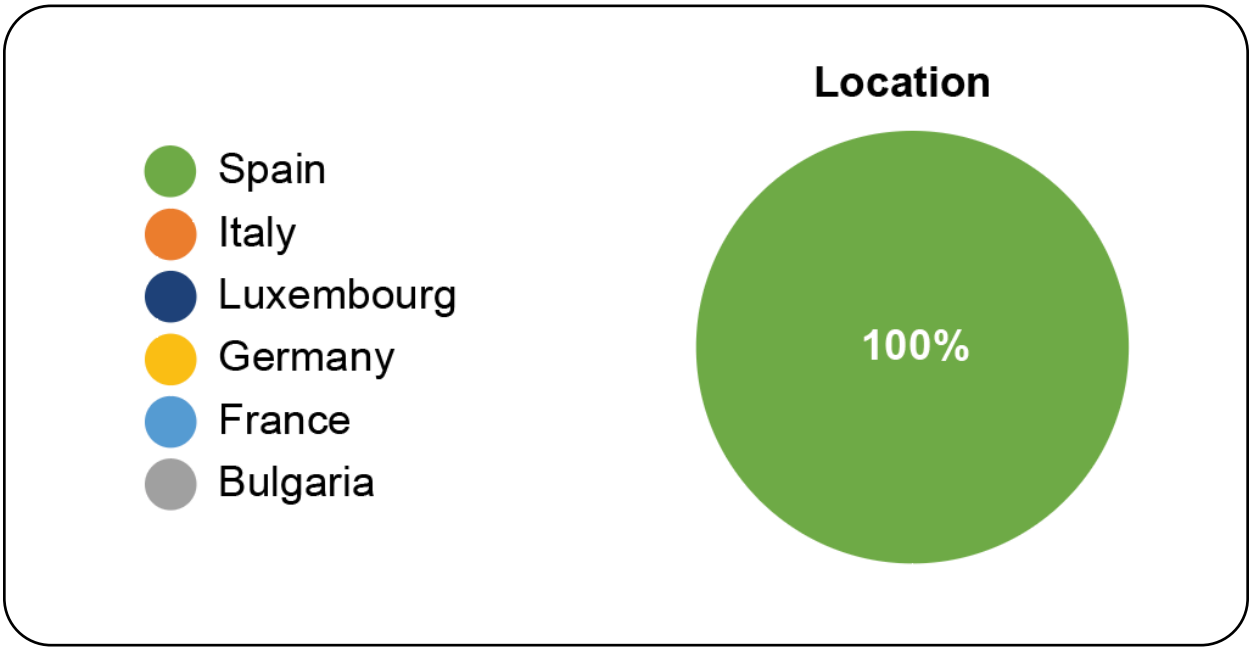


2.3. Location

20 answers

All persons that answered the survey were located in Spain.

- Spain: 20 (100%)
- Italy: 0 (0%)
- Luxembourg: 0 (0%)
- Germany: 0 (0%)
- France: 0 (0%)
- Bulgaria: 0 (0%)



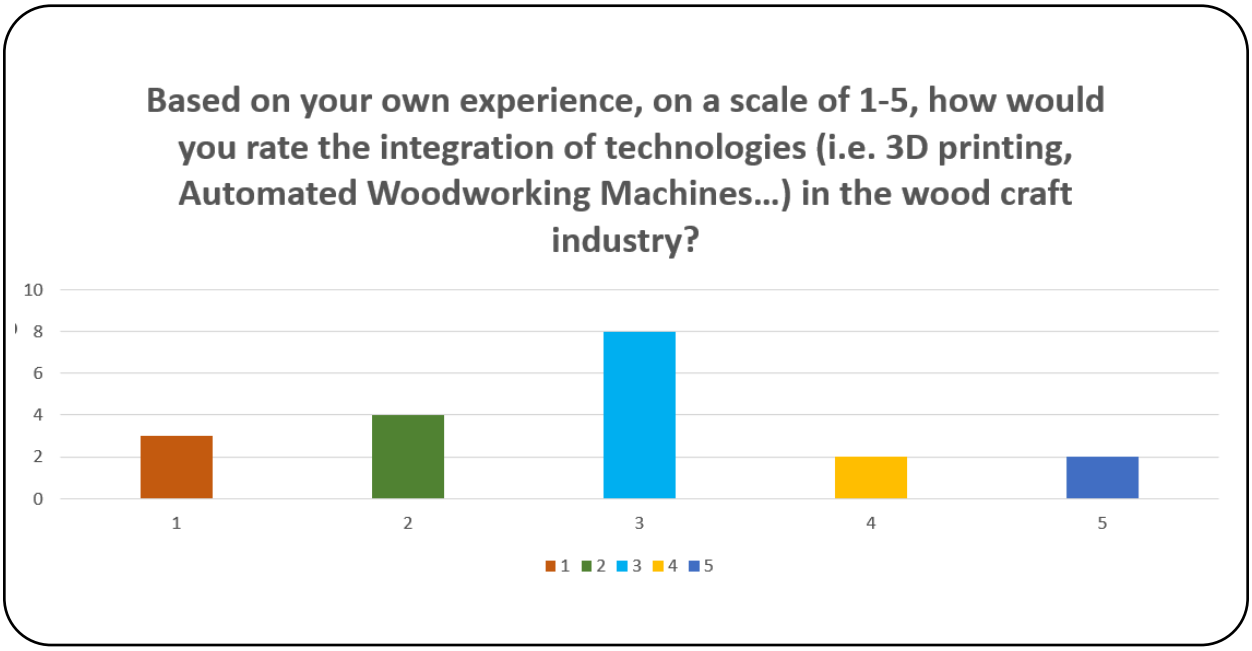
2. State-of-the-Art of technology in the wood craft sector

3.1. Based on your own experience, on a scale of 1-5, how would you rate the integration of technologies (i.e. 3D printing, Automated Woodworking Machines…) in the wood craft industry?

20 answers

The received answers are the following:

- 1: 3 (15%)
- 2: 4 (20%)
- 3: 8 (40%)
- 4: 2 (10%)
- 5: 3 (15%)



3.2. Based on your own experience, which of the following technological innovations or tools are currently in use in the wood craft industry? (Select all that apply)

20 answers

The received answers are the following

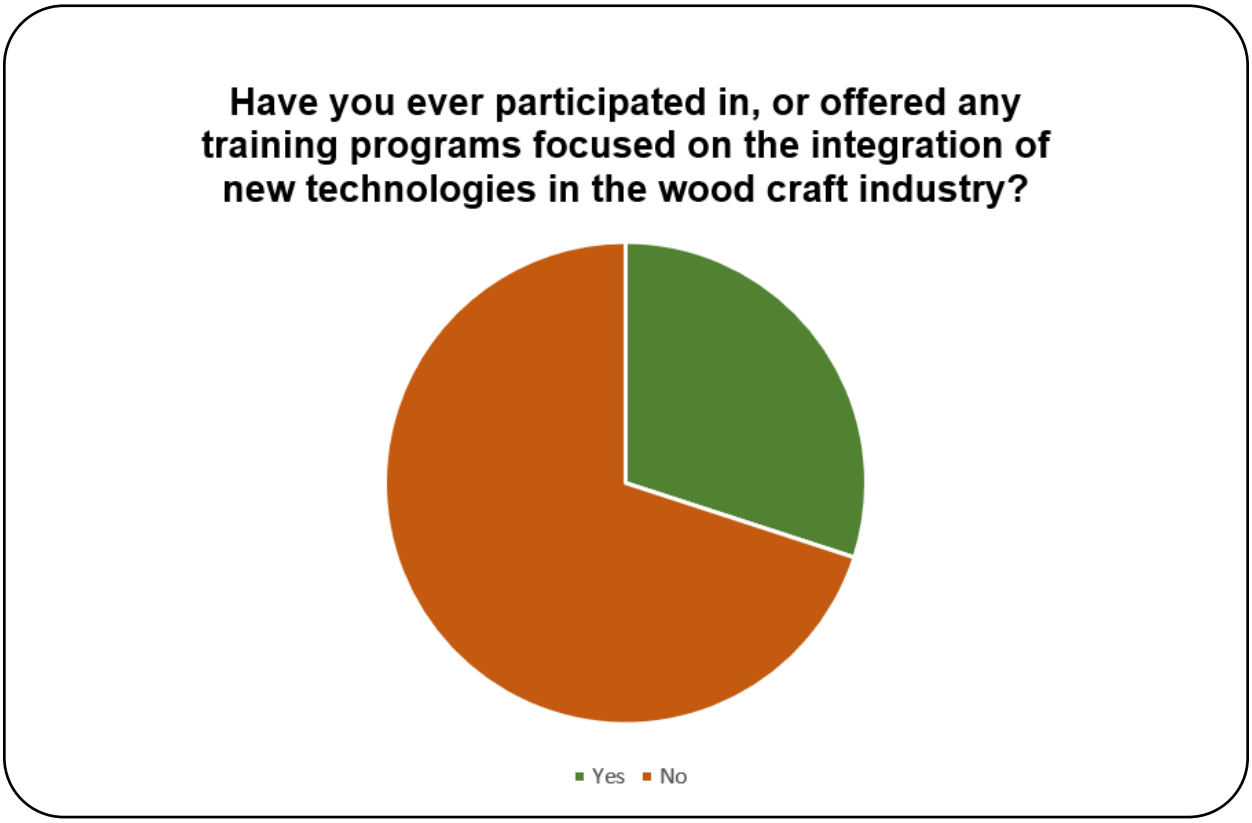
- 3D Printing: 3 (15%)
- CNC Machines: 17 (85%)
- Augmented Reality (AR): 2 (10%)
- Virtual Reality (VR): 4 (20%)
- Automated Woodworking Machines: 12 (60%)
- Other: 1 (5%)
- None of the above: 1 (5%)

3.3. Have you ever participated in, or offered any training programs focused on the integration of new technologies in the wood craft industry?

20 answers

The received answers are the following:

- Yes: 6 (30%)
- No: 14 (70%)



3.4. If yes, what were your motivations and expectations?

20 surveys, 6 answers.

The received answer was:

- I have participated in the development of training materials in 3D printing."
- Hands-on training
- Innovation
- To know new technologies to produce
- Innovation and services for the wood industries
- Identify applications

Desk Research

1.- Project/Organizations reports and presentations

Ambit Cluster (La Sénia - Barcelona - Madrid). The AMBIT cluster is the environment in which habitat and contract professionals and companies share concerns and work together to develop activities and projects:

AMBIT Cluster - Cluster de equipamiento del hogar y contract

Amuebla (Murcia). Amuebla is a non-profit business cluster, specialized in furniture manufacturing and related sectors, located in the region of Murcia.:

Amuebla Cooperación – Agrupación empresarial Innovadora de fabricantes de muebles de la Región de Murcia (amueblacooperacion.es)

Hospital Sant Joan de Déu (Barcelona). In 2016, Hospital Sant Joan de Déu Barcelona began working with 3D printing and additive manufacturing technologies for the simulation and planning of complex surgeries in four main areas: Orthognathic and Maxillofacial Surgery, Orthopedic and Traumatological Surgery, Plastic Surgery for the reconstruction of ear lobe in patients with microtia and Oncological Surgery.

Impresión 3D - proyecto de innovación del Hospital Sant Joan de Déu (sjdhospitalbarcelona.org)

Ayudame3D.org (Madrid)

Ayudame3D is a Spanish entity that designs, manufactures and delivers prosthetics (3D printed arms) to amputees around the world for free. Thanks to this, the company wants to reduce the inequality they face, improving their quality of life and providing better opportunities for schooling and employability.

They promote the social value of technology through technological-social awareness programs in order to help vulnerable groups around the world.

Protesis Brazo | Fabricación de Prótesis Solidarias Ayudame3D

3DIncubator/ (Barcelona)

The High-Tech Business incubator is a project led by “El Consorcio de Zona Franca de Barcelona” and “Fundación LEITAT”. Its goal is to incubate the 100 best initiatives related to additive manufacturing in 5 years by creating a space for the incubation of start-ups, SMEs and micro-companies that use this technology.

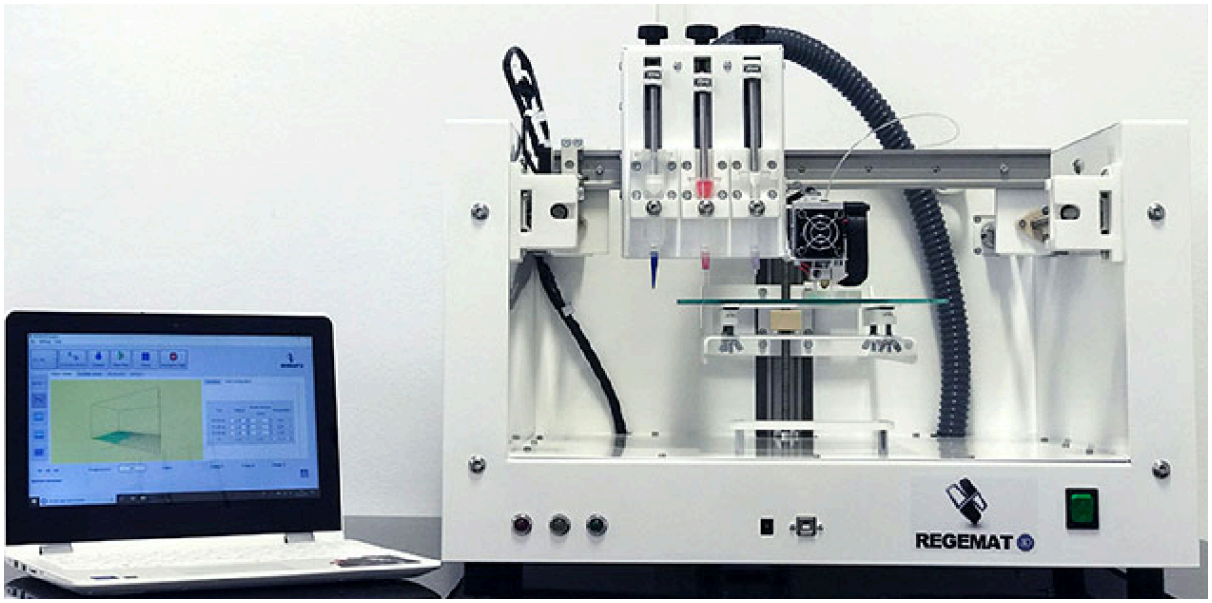
3D Incubator Barcelona (incubator3d.org)

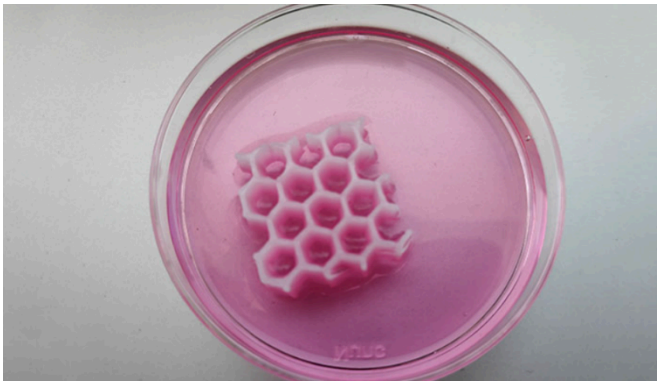
2.- Case studies

Regemat 3D (Science and technology 3D printing)

Regemat makes available to research and science a technology tailormade designed what born to integrate the advantages of the additive manufacturing with tissue engineering and applied to the regenerative medicine.

REGEMAT 3D is a company based in Granada, Spain, with almost 10 years of experience in the medical field related to additive manufacturing technologies. It is without a doubt one of the pioneering companies in the field of 3D bioprinting in Spain, and one of the companies that is most promoting the research of these technologies in the country. Every day we get closer to the so-called personalized medicine, not only in the field of prostheses, 3D implants or orthoses, but in one that will change medicine: bioprinting. This week we spoke with Jose Manuel Baena, Founder of Breca Health Care and Regemat 3D, expert in the field of bioprinting and customized medicine. He presents his projects related to this field, and talks about the importance of the introduction of 3D printing in Spanish hospitals.

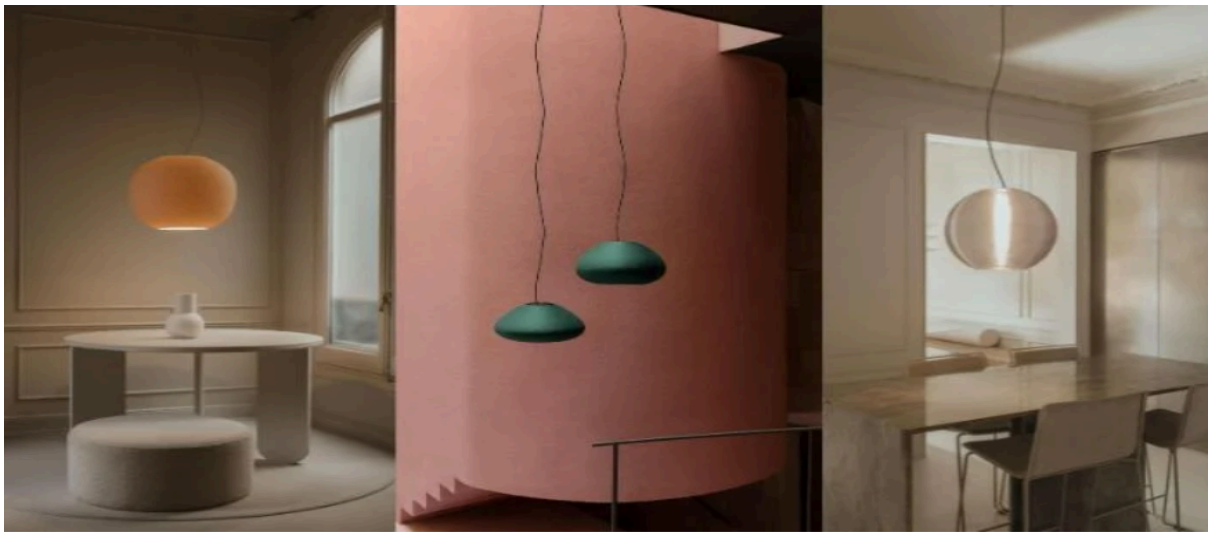




Faro (Lighting Barcelona)

With this collection, the company promotes the circularity of processes and 3D printing as a sustainable production method, therefore, it has managed to develop a large-scale additive manufacturing process at an industrial level to print these lamps in recyclable materials.

Faro Barcelona is a company that has been selling lighting products for over 75 years. His collection of luminarias called "Tierra, Mar y Aire" (Land, Sea and Air) is printed in 3D. The collection is made up of different lamps that represent each of the three elements.



Land *Sea* *Air*

The "Tierra" collection is 3D printed with PLA bioplastic and cellulose, subtly imitating bees' nests

The "Mar" collection is inspired by the shells of sea urchins and they play with three different sizes and shapes. The material used is polypropylene composite formulated from 75% recycled fishing nets and reinforced with glass fiber, claiming that fishing nets represent about 30% of the waste that is dumped into the sea and the pollution of our oceans. The "Aire" collection, since PETG is the most recycled plastic on the planet since it can be recycled several times, but only 9% of it is actually recycled. This is why the "Aire" collection is printed in 100% recycled PETG.

Nagami (Large format 3D printing)

Nagami is a Spanish company, specialized in large format 3D printing, with a clear commitment

to digital transformation and immersed in the constant challenge. They focus on the ideation and production of aesthetic and functional solutions that give life to unique conceptualizations for the architecture and design sector.

One of Nagami's well-known projects is the printing of Zaha Haddid Architects' chairs at the 2018 Milan Furniture Fair. The project was titled "Brave new world: re-thinking design and large-scale robotic 3D printing", it includes four avant-garde chair designs: "Rise" and "Bow" by Zaha Hadid Architects, "Robotica TM" by Ross Lovegrove, and "Peeler" by Daniel Widrig. All printed in 3D.

This chair designed by Zaha Hadid architects (ZHA) has been 3D printed using a non-toxic, biodegradable material from renewable sources. The seat — named ‘rise’ — has been made by Nagami, a company that specializes in 3D printing and robotic manufacturing. these chairs combine pristine design informed by structural optimization processes typically found in nature with innovative materials and the most advanced fabrication methods:

Nagami is printing a lot of products actually, architectural projects, furniture and product and digital crafts.

Alfarería Lista

Alfarería Lista was created in 1979 as a pottery company. From the beginning, innovation was sought in terms of materials, techniques and new manufacturing methods. In this new century,

innovating and seeking to improve processes, products and marketing methods.

The company opted for new technologies, among them 3D printing and modelling.

An example of the products offered in Lista Pottery: Hybrid piece: Ceramic turning + 3D printing. Stoneware piece fired at 1250 degrees.

6. NGO Nest - Germany

Introduction

In Germany, there is a noticeable gap in integrating 3D printing into the traditional woodworking sector. This is a challenge because woodworking craftsmanship is an integral part of cultural heritage, yet it could benefit from adopting innovative technologies like 3D printing.
3D printing offers new opportunities for rapid prototyping and customization of wooden products, but there is a lack of specific programs to help artisans fully harness this potential. Companies like Voxeljet are already showcasing the possibilities of 3D printing in art and sculpture production, but greater awareness and training are needed for traditional artisans to facilitate the integration of 3D printing into the woodworking industry.

Best Practice 1

Digitalwerk

Topic	3D printing
Best practice title	3D printing workshop: limits and possibilities in crafting
Keywords	3D printing, crafting, workshop
Best practice	The *Digitalwerk Werder* is a project run by the "Institut für Innovations- und Informationsmanagement GmbH (ifii)". It offers free support for the skilled trades in small and medium-sized enterprises with digitalisation projects, business models, service and product innovations. They offer experience stations, workshops, online seminars and events where digital technologies for the skilled trades and SMEs can be experienced and tried out. *Digitalwerk* is supported by funding from the European Union and the state of Brandenburg. In 2019, *Digitalwerk* offered a workshop on 3D printing, which focused on the limits and possibilities of 3D printing in the skilled trades. Various possible applications in crafting were demonstrated using practical application examples and printed directly on-site. The workshop also explained the

	process's functions, advantages and limitations, and the work steps required for 3D printing. In the practical part of the workshop, a 3D model was selected. This was adapted for the 3D printer and a model was printed out during the workshop. The workshop was aimed at all SMEs and craft businesses interested in this manufacturing technology.
Reference Link (if any)	https://digital-werk.org/veranstaltungen/3d-7druck/
Provided by	*- Name of the Institution/Partner that implemented the practice:* Digitalwerk-Zentrum für Digitalisierung im Mittelstand *- Contact of the Institution/Partner (name, email, telephone):* Digitalwerk Werder Eisenbahnstraße 109 (im Bahnhof) 14542 Werder (Havel) Telefon: +49 3327 5658-0 E-Mail: info@digital-werk.org; Webseite: www.digital-werk.org *- Name of the Strategy/Programme:* *- Other useful information (if any):*
Language	ENGLISH

Best Practice 2

Handwerkdigital NRW

Topic	
Best practice title	3D printing: a multifunctional tool for many industries
Keywords	3D print, craft, project, management

	consultancy
Best practice	HANDWERK-DIGITAL.NRW is a digitalisation platform for skilled trades businesses in North Rhine-Westphalia. It is a joint project of the Dortmund Chamber of Skilled Crafts (Handwerkskammer Dortmund), the Ostwestfalen-Lippe Chamber of Skilled Crafts (Handwerkskammer Ostwestfalen-Lippe) in Bielefeld and the North Rhine-Westphalia Carpentry and Metalworking Trade Associations. The platform offers craft businesses detailed information, many digital tools and support on all aspects of digitalisation. For example, questions on funding, adapting business models and improving the visibility of homepages are answered. The project also deals with the process of 3D printing, among other things. They also deal with the following questions: "Which digital, innovative tools can make work easier for trades people?", "What financial assistance is available from the federal and state governments to help tradespeople establish digital business processes and where can they find advice in their area?" and "Can I integrate 3D printing production technology into my company?". They also offer an online magazine about 3D printing and news, an online seminar on additive manufacturing from the 3D printing location in Germany (which can be found on the website and YouTube) and individual and free advice in your own company.
Reference Link (if any)	https://handwerk-digital.nrw/schwerpunkte/neue-technologien/3d-druck/
Provided by	*- Name of the Institution/Partner that implemented the practice:* Handwerk-Digital.NRW *- Contact of the Institution/Partner (name,*

	email, telephone): Landes-Gewerbeförderungsstelle des nordrhein-westfälischen Handwerks e.V. (LGH) Auf´m Tetelberg 7 40221 Düsseldorf Telefon: +49 211 30108 -0 Telefax: +49 211 30108 -500 Internet: www.lgh.nrw E-Mail: info@lgh.de *- Name of the Strategy/Programme:* *- Other useful information (if any):*
Language	ENGLISH, GERMAN

Best Practice 3

Initiative Mittel- und Osteuropa e.V.

Topic	3D-printing
Best practice title	3D-ECO course
Keywords	Craft, 3d-print, NGO, Erasmus plus
Best practice	The Initiative "Mittel- und Osteuropa e.V. (InMOE)" is an international, non-profit network that empowers, unites and inspires young civil society actors to bring about positive change in their communities. Headquartered in Berlin, Germany, it connects around 30 different member organisations from Belarus, the Czech Republic, Germany, Moldova, Poland, Romania and Ukraine. The project offers the workshop "3D-ECO Course". This equips Berliners with skills for the present and the future. The course aims

	to teach basic skills in 3D design and 3D printing, combined with a practical introduction to recycling and upcycling. The project is also funded by the EU through Erasmus+. The topics covered by the workshops are 3D printing, sustainability and upcycling. The course consists of several training sessions (workshops), which last a total of 3 weeks. At the end of the training, participants will demonstrate their acquired skills by combining their own 3D-printed objects with upcycled clothing to design and communicate their own slogans for freedom, mutual respect, democracy, the environment or other important messages. The project is primarily looking for participants who live in Berlin, are between 16 and 29 years old, go to school or university or are Ukrainian refugees. Furthermore, participation is free of charge, but a donation is welcome.
Reference Link (if any)	https://initiative-moe.de/home-1
Provided by	*- Name of the Institution/Partner that implemented the practice:* Initiative Mittel- und Osteuropa e.V. *- Contact of the Institution/Partner (name, email, telephone):* Initiative Mittel- und Osteuropa e. V. c/o Otari Glonti Wichertstraße 41 10439 Berlin Germany E-Mail: info@initiative-moe.de *- Name of the Strategy/Programme:* *- Other useful information (if any):*
Language	ENGLISH, GERMAN

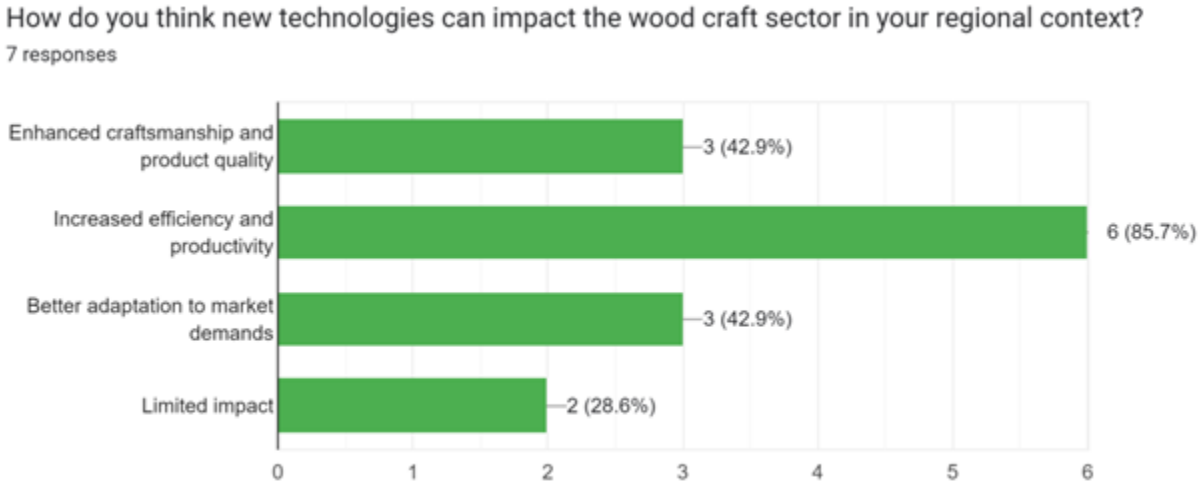
Survey and Focus Group

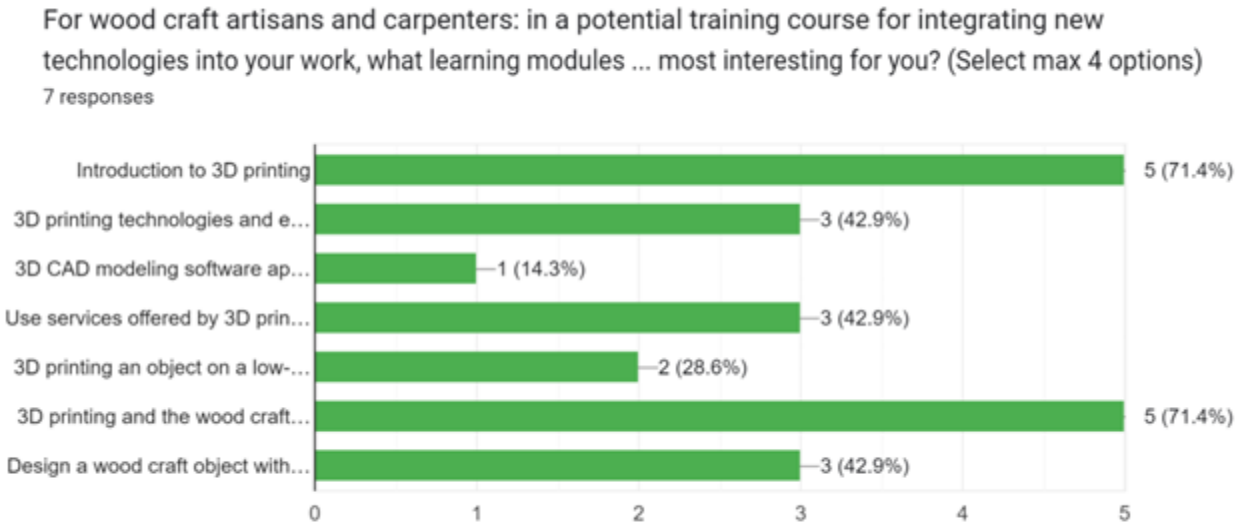
Of the 7 respondents to the survey in Germany, none were under the age of 18. The age was very variable, 2 participants were between the ages of 18-25, two were between the ages of 26-35 and the other 2 participants were between 36-45. One participant was over the age of 46. The majority works in the occupational field as woodcraft artisans, two VET teachers and one participant is a VET trainee. Furthermore, everyone was located in Germany.

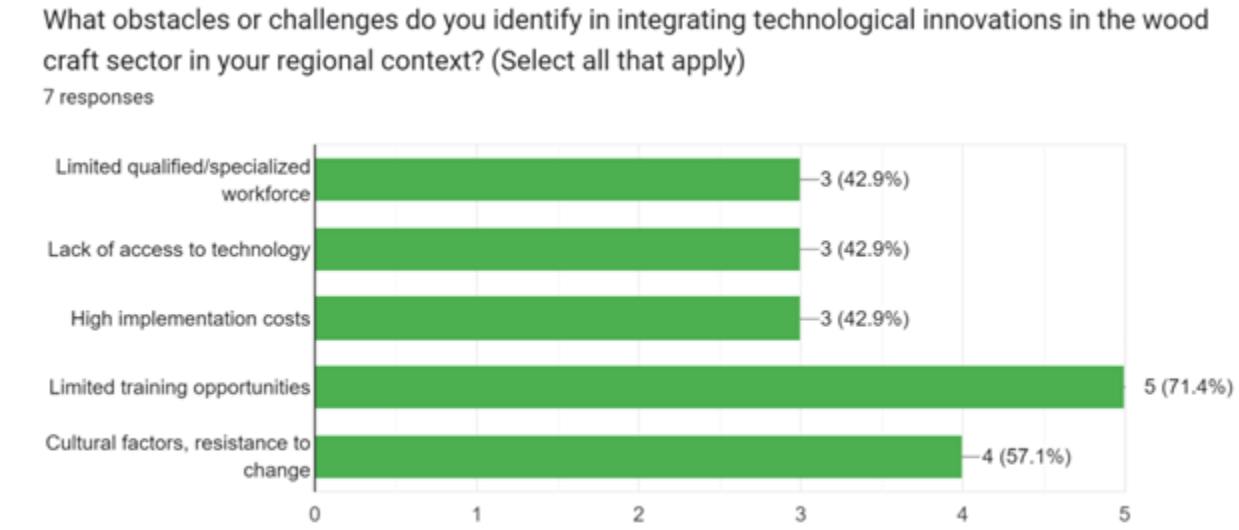
Based on their own experience, every participant rated the integration of technologies (i.e. 3D printing, Automated Woodworking Machine etc.) in the wood craft industry high or very high. And automated woodworking machines and 3D-printing are technological innovations or tools that are currently in use in the wood craft industry.

Regarding wood craft artisans and carpenters, they regularly attend workshops and training sessions, peer reviews and feedback and do self-assessment based on practical application to assess their progress in integrating new technologies into their activity.

The current needs that could be fulfilled thanks to the adoption of 3D printing and other new technologies in the wood craft sector are: 3D printing because it allows for the creation of highly customized woodcraft products, catering to individual preferences and needs, and new tools that let you get fancy with your woodwork. Through these tools, you can carve out very intricate patterns or shapes which were impossible before. Furthermore, the participants agreed that Automation helps you work faster.







Desk Research

The project CRAFT3D aims to enhance traditional craft practices in the wood manufacturing sector by leveraging 3D printing and technology innovation. The project focuses on developing a VET (Vocational Education and Training) curriculum delivered through a MOOC (Massive Open Online Course), along with a work-based learning experience and assessment tool tailored for digital environments. In the following desk research will be presented where an

analysis of the local and national context is investigating the needs and opportunities of the target group.

During our research into the intersection between 3D printing technology and the wood sector in Germany, we have identified a noticeable gap in initiatives, programmes, workshops and similar ventures specifically tailored to the wood craft sector. While a rich wealth of information is available on the intricacies of 3D printing per se, there is a distinct lack in the seamless integration of this technology into the context of the German wood industry.

Traditional craftsmanship is more than just a skill; it is a time-honoured tradition that has been passed down from generation to generation. It is a way of preserving cultural heritage and ensuring that the skills and techniques of the past are not lost to time. Craft start-ups that focus on traditional techniques help to keep these traditions alive by enabling craftsmen to continue practising their craft and passing on their knowledge to future generations.

The development of craft start-ups requires innovation. There are challenges for traditional craftspeople because there is a lack of engagement with new techniques and technologies. Traditional artisans often face challenges when it comes to keeping up with the latest techniques and technologies in their respective fields. Because they rely on centuries-old practices, they may not have access to resources that can help them innovate and improve their craftsmanship. For example, a traditional blacksmith who forges metal using traditional methods may not be aware of advances in metalworking technology such as 3D printing or laser cutting. This lack of awareness limits their ability to explore new possibilities and integrate modern techniques into their craft.

First of all, some general information about 3d printing. There are currently five scenarios in which additive manufacturing processes are used. The first one is the realisation of new ideas and design. The second one is the cost-effective production of individual parts or small batches. Third, the individualisation of products (e.g. production of medical implants). Then the shortening of the supply chain. And lastly, the repair applications in which only the defective parts are replaced.

Let us now turn to the possibilities of 3D printing in connection with woodworking. 3D printing makes it possible to produce prototypes of wooden products in a fast and cost-effective process. This can be particularly useful when it comes to testing complex designs or creating customised wooden products.

There are also 3D printers that have been specially developed for processing wood filaments. These filaments contain a high proportion of wood fibres, resulting in an end product with a wood-like texture and appearance. This opens up new possibilities for the production of decorative and functional wooden objects. Digital technologies can play a role in traditional wood workshops. CNC (Computerised Numerical Control) machines, for example, are used for precise and complex cuts in wood. These machines can also work with 3D models and digital designs due to their computerized control.

Voxeljet, the start-up from the Technical University of Munich, is one of the leading manufacturers of industrial 3D printing systems for the tool-free production of mopduls and models with headquarters in Germany (Augsburg) and subsidiaries in the USA, UK, China and India. The company has a finely tuned product range that extends from smaller research systems to large-format industrial machines and can therefore offer the perfect 3D printing system for almost any size requirement.

They use additive manufacturing as an artistic tool. They led a project in Freising, where a 3.3 meter statue of Saint Boniface was created using the latest 3D printing technology. The statue was designed by the German artist and bronze caster Bruno Wank and the realisation was completed using 3D printing. The artist Bruno Wank has a wealth of experience in the field of bronze casting. He has also been working with 3D printing technology for five years.

Voxeljet also sponsored a project in Munich's Westpark. Fabian Hesse and Mitra Wakil created a life-size sculpture group "Westpark Clouds" for the residential neighbourhood in Munich's Westpark, an artistic work in public space. Westpark Clouds shows a two-part group of figures, developed from the manipulated and edited 3D scans of the new residents.

The company has other projects that are dealing with 3D printing, such as: a work of art that has adorned a roundabout in Friedberg (Bavaria) since June 2018, "Growing Stones" by Timm Ulrichs from Karlsruhe or "The Pugilist of the Quirinal" and "The Ruler of the Baths" by Professor Vinzenz Brinkmann from Frankfurt.

https://fastercapital.com/de/inhalt/Von-der-Tradition-zur-Innovation--Die-Entwicklung-handwerklicher-Startups.html

https://www.mittelstand digital.de/MD/Redaktion/DE/Unternehmerfragen/Standardartikel/3-wie-funktioniert-die-digitalisierung-2-welche-vorteile-haben-additive-fertigungsverfahren.html

https://www.voxeljet.de/ueber-voxeljet/

7. Conclusion

The desk research conducted across Luxembourg, Italy, Bulgaria, Spain, and Germany provided valuable insights into the wood crafting sector's engagement with 3D printing technologies and innovative educational practices. Each country showcased unique approaches and initiatives aimed at enhancing skills, fostering innovation, and integrating technology within the craft sector.

While Luxembourg showcased a strong tradition of woodworking craftsmanship, there was a notable lack of skills in 3D printing, highlighting the need for targeted educational initiatives. In Italy, the VET School of Woodworking and Interior Architecture demonstrated a diverse range of specialties, with 3D printing slowly entering the curriculum, presenting opportunities for skill enhancement and innovation. Bulgaria's involvement in the broader European market emphasized the country's engagement with 3D printing technology. Spain and Germany also showcased initiatives integrating 3D printing technologies to enhance skills and foster innovation in the wood craft sector.

Luxembourg: The innovative best practice of BTS Wood Technology in Luxembourg exemplifies effective collaboration between VET and craftsmen, focusing on tailored educational programs, apprenticeship opportunities, and lifelong learning initiatives. The success of this initiative lies in its commitment to industry-integrated curriculum and mentorship programs, fostering continuous professional development.

Italy: The research conducted by EURONET and Camera di Commercio della Basilicata in Italy highlighted the importance of innovation technology in wood crafting. For instance, the best practice of "ABITARE MEGLIO" emphasized the benefits of wood as a construction material, promoting comfort, sustainability, and eco-compatibility. This approach aligns with the principles of living well-being and environmental preservation.

Bulgaria: The research in Bulgaria, carried out by BIC Innobridge, focused on the broader European market and the engagement with 3D printing technology. The best practices showcased the country's efforts in integrating innovative technologies within the craft sector, emphasizing sustainability and creativity.

Spain: The research in Spain, conducted by AMBIT, highlighted the importance of innovation hubs and workshops for craftsmen to explore new technologies and materials. The best practices in Spain emphasized the role of innovation in enhancing skills and fostering creativity within the wood craft sector.

Germany: The research in Germany, led by NGO Nest, emphasized the significance of mentorship programs and lifelong learning initiatives for craftsmen. The best practices in Germany focused on skills transfer, professional development, and the nuances of running a successful craft business.

Each country showcased unique strengths and approaches in integrating 3D printing technologies within the wood crafting sector. Luxembourg excelled in tailored educational programs and apprenticeship opportunities, Italy emphasized sustainability and eco-compatibility, Bulgaria focused on innovation and creativity, Spain prioritized innovation hubs, and Germany highlighted mentorship and lifelong learning initiatives.

These findings underscore the importance of collaborative efforts, knowledge exchange, and best practice sharing among countries to foster innovation, enhance skills, and promote sustainability within the wood craft sector.

This comparative analysis provides a foundation for developing a comprehensive program that integrates the best practices from each country, aligning with Luxembourg's unique requirements and positioning it as a leader in 3D printing technology integration within the wood crafting industry.

Recommendations:
Based on the findings, the following recommendations are proposed for the development of MOOC modules focusing on 3D printing and its application in the wood craft sector:

1. Introduction to 3D Printing: Provide a comprehensive overview of 3D printing technology, its principles, and applications in various industries.
2. 3D Printing Technologies: Explore different types of 3D printing technologies, materials, and processes to enhance understanding and skill development.
3. 3D Printing Equipment: Cover the selection, operation, and maintenance of 3D printing equipment to ensure proficiency in handling the technology.
4. Obtain the Physical Model Using Services Offered by 3D Printing Providers: Guide learners on how to collaborate with 3D printing service providers to bring their designs to life.
5. 3D Printing and the Wood Craft Sector: Focus on the integration of 3D printing in wood crafting, showcasing its potential for innovation, sustainability, and creativity.
6. Case Studies in Wood Manufacturing: Present case studies demonstrating the impact of 3D printing on sustainability, creativity, and innovation in the wood manufacturing industry.

These six modules have been identified based on the desk research findings that highlight the need for skill enhancement, innovation, and the integration of 3D printing technologies in the wood craft sector. By offering these modules as MOOCs, learners can access flexible and interactive learning opportunities to acquire knowledge and practical skills in 3D printing. The selected units aim to bridge educational gaps, promote creativity, and empower individuals in the wood crafting industry to leverage technology for sustainable and innovative practices.

8. Disclaimer

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